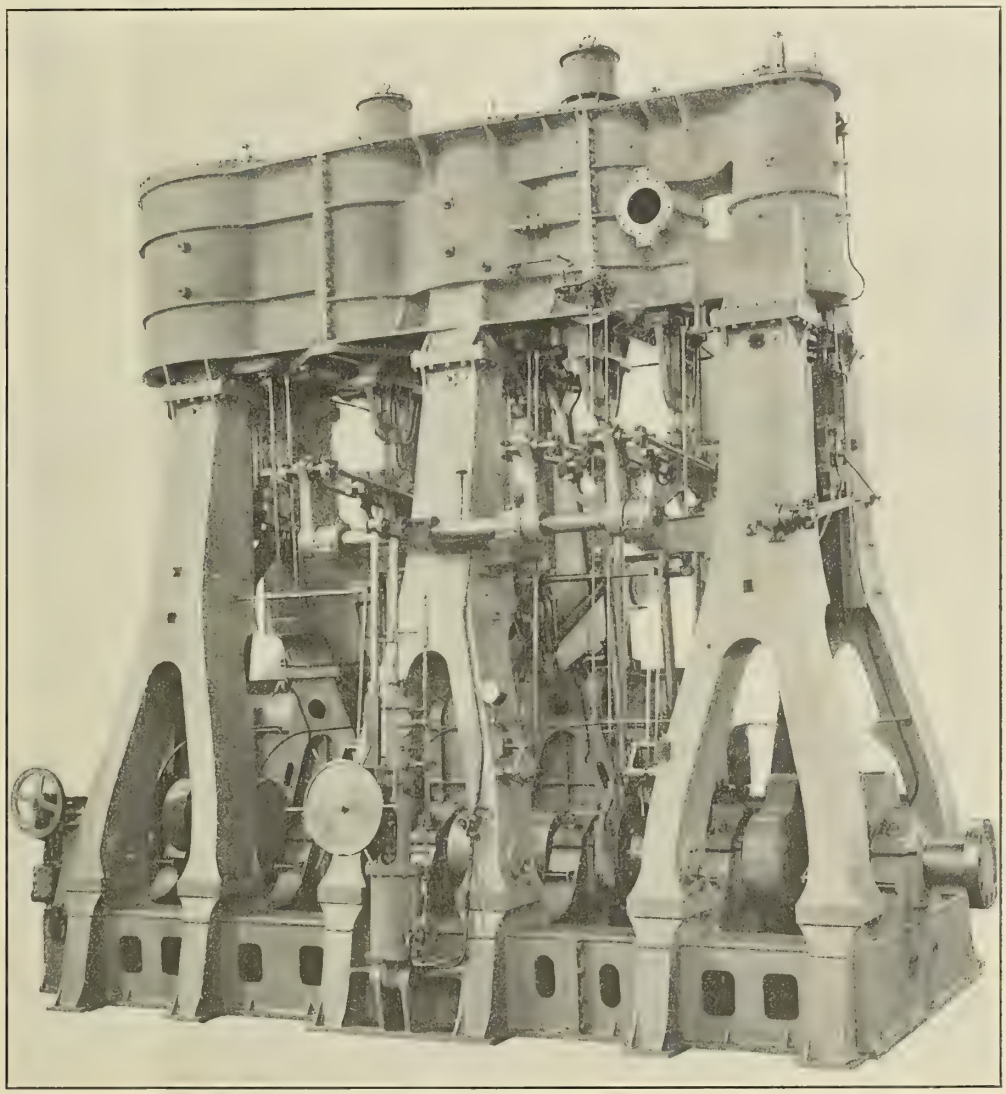
International Marine Engineering

MARCH, 1908.

THE NEW BRAZILIAN LINER VERDI.

This new steamer, which was built and engined by Workman, Clark & Company, Ltd., Belfast, has been especially designed for the carriage of cargo and passengers between New York and the east coast of South America. She sailed from New York on her first trip on Jan. 20. It is the intention of her owners, the Lamport & Holt Line, to establish a semi-monthly service, three other similar steamers being now under construction. The construction of the vessel and machinery has been carried out under the supervision of the British Corporation surveyors to qualify for the highest class in their registry, while the requirements for the Board of Trade passenger certificate have also been fully complied with.

The ship is rated as a two-deck and shade-deck vessel, schooner rigged, and has a gross tonnage of 6,578, the net tonnage being 4,180. The length is 430 feet 4 inches, with a beam of 53 feet 4 inches and a depth of 43 feet 6 inches. With a draft of 24 feet 1½ inches the displacement is 11,200 tons, and the tons per inch are 46. When carrying dead weight of 7,650 tons the displacement becomes 12,400 tons, and the draft 26 feet 3½ inches. With 7,940 tons dead weight and a draft of 26 feet 10 inches the displacement is 12,690 tons. With 8 220 tons dead weight and 12,970 tons displacement, the draft is 27 feet 4½ inches. There are eight water ballast tanks, with a total capacity of 1,095 tons.



FRONT SIDE OF THE TRIPLE EXPANSION ENGINE OF THE BRAZIL LINER VERDI.

Special attention has been given to the first-class passenger accommodation, which is arranged amidships on the upper, shelter, bridge and promenade decks. One very noticeable feature is the great headroom of 9 feet between decks. The fifty-one staterooms for first-class passengers are designed for accommodating 102 persons. By making use, however, of the settees 153 may be carried. Arrangements are also provided for 52 second-class and 196 steerage passengers.

The large and well-appointed staterooms are arranged along the sides of the vessel, and designed to give the maximum of comfort in a hot climate. Several pairs of these rooms have communicating doors, so that they can be occupied as family suites if so desired. These staterooms are tastefully furnished in mahogany, and, the walls being enameled white, have a comfortable, cool appearance, which will be much appreciated in the warm climates for which the vessel is intended.

The dining saloon is a handsomely designed apartment, placed at the forward end of the bridge house and extending the full width of the vessel. The walls are paneled in light oak, with gold ornaments, while the ceiling is finished in white. The furniture, which is all in oak, of the same shade as the paneling, has been arranged on the restaurant principle, seats for 106 persons being provided. This apartment is efficiently lighted by large cottage windows at the fore and large round lights along each side. From the after end of the saloon a well-proportioned oak staircase leads up to the entrance hall on the bridge deck and the saloon lounge on the promenade deck. The entrance hall gives access to the bridge deck, at each end of which sheltered recesses have been arranged, and provided with comfortable garden seats.

The saloon lounge on the promenade deck is a luxurious apartment, the walls and ceiling of which are finished in white, the paneling being relieved with beautifully painted medallion portraits of the world's famous musicians, done in Bartolozzi style, the portrait of Verdi, the famous composer, being placed over the piano. The furniture, consisting of bookcase, writing tables, chairs and settees, is in light oak, the seats being upholstered in tapestry. The room is lighted by large cottage windows, shaded by dainty-colored silk curtains. The boat deck affords ample space for promenading, and on this deck is the smoke room, which is handsomely paneled and furnished in walnut, the settees and chairs being upholstered in crimson leather. Adjoining this apartment, a well-sheltered alcove has been built and suitably furnished with tables and comfortable chairs, affording a pleasant lounge in the open air.

The sanitary arrangements and the ventilation of all the compartments have received especial attention, and will be found to be of the most up-to-date and satisfactory character, a thorough system of mechanical ventilation having been introduced. Second-class accommodation has been provided in the poop, where a number of commodious staterooms have been arranged at the sides of the vessel, with the dining saloon in the center. The captains' and officers' quarters are located in a steel house situated upon the bridge deck, convenient to the navigating bridge, while the engineers' and petty officers' rooms are placed along the starboard side of the vessel on the upper deck, convenient to the engine-room entrance.

The four large holds into which the cargo space is divided are almost entirely free from obstruction, the decks being supported by fore-and-aft girders in place of the usual system of hold pillaring. This arrangement affords ample space for the storage of the largest class of consignments, such as locomotives, railway carriages, boilers, etc., while in anticipation of this class of cargo the hatchways have been constructed as large as possible. Each of the hatchways is equipped with four steam winches of the most powerful type, with a suitable number of derricks, capable of handling a full cargo in the most expeditious manner.

The ship is propelled by one screw operated by a triple-expansion engine with cylinders 28, 47 and 78 inches in diameter and a stroke of 57 inches. This gives 3,850 indicated horsepower with 200 pounds boiler pressure and a designed speed of 12.75 knots. The speed on trial, Dec. 18, 1907, was 14.15 knots. The crank shaft has a diameter of 15⅞ inches, the line shaft 15 inches, and the propeller shaft 17 inches. The propeller is of bronze, with four blades, and has a diameter of 18 feet 6 inches. It is set to a pitch of 19 feet, which gives a pitch ratio of 1.026; the pitch is adjustable down to 18 feet. The engine room is 67 feet 6 inches long.

BROADSIDE VIEW OF THE LAMPORT & HOLT LINE STEAMSHIP VERDI, WITHOUT CARGO ABOARD.

There are three double-ended Scotch boilers, measuring 15 feet 6 inches in mean diameter by 18 feet in length. Three furnaces in each end of each boiler make a total of eighteen fires. These furnaces, which are corrugated, have each an internal diameter of 45 inches. The total heating surface of the boilers is 13,430 square feet, with 354 square feet of grate. This makes a ratio of 38 to 1. A single-ended donkey boiler, operating at 110 pounds pressure, measures 14 feet in diameter and 10 feet 6 inches long; it has three furnaces.

The regular coal bunker stowage capacity, figured on a basis of 43 cubic feet per ton, is 1,415 tons. On the same basis, the capacity of the reserve bunkers is 1,802 tons. This makes a total of 3,207 tons. It is estimated that the ship will require twenty-two days to reach the Rio Plata, and that the coal consumption will be 65 tons per day. This makes 1,430 tons, and with 40 tons for use in the harbors of Bahia, Rio de Janeiro and Santos, the requirement calls for 1,470 tons. As it is out of the question to obtain satisfactory coal in South America

at a satisfactory figure, the ship has to carry from New York enough coal for the round trip. There is provided for homeward steaming 1,510 tons and a margin of 150 tons, or a total of 1,660. This makes the total coal requirement on leaving New York 3,130 tons.

The equipment includes two Hall's bower anchors of 79 cwt. each, and one of 67¼ cwt.; a Rodgers stream anchor of 22¾ cwt.; a Rodgers kedge of 9½ cwt.; 300 fathoms of 2⅜-inch stud link chain, and 90 fathoms of 1 5/16-inch stream chain. There are two fresh water tanks, with a capacity of 5,950 gallons each.

THE HEATING AND VENTILATING OF SHIPS.

BY SYDNEY F. WALKER, M. I. E. E.

FORMS OF HEATING APPARATUS WITH HOT WATER.

Hot-water apparatus for heating rooms, cabins, alleyways, corridors and so on may consist simply of pipes laid around the rooms, the saloons, etc., and through the corridors; or, as is more frequently arranged, what are termed "radiators" may be employed. The term radiator is a misnomer. As is explained below, the heat delivered by the heating appliance is only partly by radiation. On the other hand, the plain pipes that were employed in the early days of steam and hot-water heating are quite as much radiators as the forms of apparatus usually so denominated. Any pipe in which hot water or steam is passing gives off heat at a rate directly proportional to the difference of temperature between the water and the air on the outside, and again in direct proportion to the extent of surface exposed, and directly to the conductivity of the substance of which the pipe is composed, and inversely in proportion to its thickness.

This law in its simple form is, however, applicable only to small differences of temperature and small values of temperature of the surrounding air. The heat is given out in two ways, by radiation and by convection. Heat passes from a heated body in all directions, through the air and whatever substances may surround it, by what is called radiation. Radiant heat, as the heat delivered by radiation is termed, has the peculiar property that it passes through air without delivering much heat to the molecules of the air itself. Heating from fires, stoves, etc., though it is due almost entirely to radiation, arises from the fact that the radiant heat is absorbed by the articles of furniture in the room, by the walls, etc., and is afterwards given out by them, partly by re-radiation, partly by convection, and partly by conduction. In addition to the above, any heated body present in air, as in any room, cabin, corridor, saloon, etc., gives rise to convection air currents. The air in the neighborhood of the heated body becomes warmer than that slightly removed from the body and is pushed upwards by the weight of the colder air, a fresh supply of air taking its place, becoming heated again, and so on, the result being that a continual circulation of air is produced, until the temperature of the room is raised to that of the heated body, or as long as heat is delivered to the body, and is carried off by the surrounding air. Every heated pipe and radiator, therefore, gives off heat both by radiation and by convection, or, as it is sometimes termed, by air contact.

Different bodies have different radiating properties. Cast iron, for instance, radiates 0.65 B. T. U. per square foot per hour for each degree F. difference of temperature between itself and the surrounding atmosphere; wrought iron, 0.57 unit; rusted cast or sheet iron, 0.67 unit. The heat distributed by convection is independent of the nature of the heated body, but varies with the form of the body. Cast iron, wrought iron, wood, etc., if heated to the same temperature, give rise to the same distribution of heat, but the quantity given off varies with the form. The quantity of heat delivered by any hot-water pipe or radiator depends directly upon the difference of temperature between the body and the air, upon the surface of the heated body exposed to the air, and upon its form. This again, as with radiation, is true only for low figures. When the difference of temperature between the heated body and the surrounding air does not exceed 30 degrees F., and when the temperature of the air surrounding the body does not exceed 60 degrees F., the above laws for radiation and for convection or air contact hold good; but when the difference of temperature exceeds the above figure, and when the temperature of the air surrounding the heated body exceeds 60 degrees F., the rate at which heat is delivered to the air increases, and at a very much more rapid rate than the increase of the difference of temperature.

The French *savants* Dulong and Petit experimented upon the subject some years ago, and their experimental facts have been confirmed by another French *savant,* Peclet, whose name will be remembered in connection with the laws of transmission of heat in refrigerating matters, and they have produced some very complicated formulae, which need not be given here, but from the results of which Mr. Thomas Box, whose standard book on "Heating" is well known, has worked out a table of what he terms ratios, representing the number by which the result of the simple laws referred to above must be multiplied, to give the correct results. The multiplier or ratio, as Box calls it, ranges from unity up to six. That is to say, the results obtained by applying the simple laws given above, for the quantity of heat delivered by a hot water or steam pipe, with a certain difference of temperature, and the other conditions as mentioned, have to be multiplied by a factor varying from a trifle over one up to six, to obtain the actual results. It will perhaps be sufficient if a few figures are given.

For a difference of temperature of 108 degrees, which is approximately that which would rule between the temperature of water in a hot-water radiator at 173 degrees F. and the surrounding air under conditions showing a temperature of 65 degrees F., the multiplier is 1.4. For a difference of temperature of 160 degrees F., which is what would probably rule with steam heating, the multiplier is in the neighborhood of 1.6. Approximately, therefore, for the conditions of heating by hot water or steam, the laws given above will show the quantity of heat delivered to the air, when a multiplier of 1.5 is brought into the equation.

Taking ordinary working conditions, the formula for the quantity of heat delivered by a hot-water radiator would be as follows:

$$Q = R\ (T - T_1) \times 1.4 + A\ (T - T_1) \times 1.4,$$

where Q is the quantity of heat in B. T. U. delivered to the air per hour, for each square foot of surface of the radiator exposed to the air; R is the rate at which heat is delivered by radiation; A that by convection, and T and T_1 are the temperatures of the radiator and the surrounding air.

It was mentioned above that the form of the heated surface exercises an influence upon the heat delivered to the air by convection currents, or, as it is termed, by contact. Thus a sphere delivers very much more heat per unit of surface, and with a given difference of temperature, than either a vertical or a horizontal cylinder. The apparatus most employed in heating, by hot water or steam, is either a horizontal cylinder in the form of pipes fixed as explained, or vertical pipes in the forms that have been given to radiators. For horizontal pipes, the quantity of heat delivered to the air in contact with the pipe, for every degree F. difference of temperature, and for every square foot of surface of pipe, for the pipes usually employed, is as follows: With 2-inch pipe, 0.728 unit; 3-inch, 0.626; 4-inch, 0.574; 6-inch, 0.523 unit. These figures are the values of A. For radiators the problem is rather more complicated, in the matter of convection.

The French savants referred to have threshed the matter out, and have produced some formulae applicable to all cases, as a result of their experiments, and the formulae are apparently pretty correct in practice. They are very complicated, however, and it will be perhaps sufficient if it be mentioned that heat liberated by convection from a sphere is considerably more for any given surface, and in a given time, than from a cylinder; and again the heat liberated from a horizontal cylinder, of a given diameter, is usually more than from a vertical cylinder of the same diameter. The rates for horizontal cylinders given above were taken from Mr. Box's book.

The rate with vertical pipes does not appear to have been measured, but Professor Carpenter* and others have made some very interesting experiments upon radiators of different forms, heated by steam and hot water. The radiators experimented on were of various forms, among them those shown in the drawings; also some consisting merely of iron pipes of different diameters and different lengths, arranged some horizontally and some vertically; also pipes and other arrangements with ribs cast on them, brass tubes plain and corrugated, and other forms. The net result of the experiments conducted by Carpenter, and by others whose work he quotes, appears to be a liberation of heat, the combined effect of radiation and convection, ranging from 1.25 B. T. U. per square foot of surface per 1 degree F. difference of temperature between the heated surface and the surrounding air, per hour, up to 2.89 B. T. U.

The best results are obtained with pipes or radiators of small sectional area, the highest having been obtained from a plain wrought-iron pipe 1 inch in diameter, 100 feet long, in a single horizontal line. Increasing the size of the pipes or the radiator equivalent, though increasing the total amount of heat liberated from a given length of radiator or pipe, decreases the rate per square foot per degree, etc. Fixing ribs upon the outsides of pipes, which has been adopted by some manufacturers, with the idea that the increased surface gives increased liberation of heat, are shown by the experiments quoted by Professor Carpenter to have the opposite effect. Thus, a plain cast-iron pipe without ribs liberated 2.54 B. T. U. per degree per hour, while a similar pipe, ribbed, liberated only 1.72 units. Cast iron gives better results than wrought iron, on account of its higher radiation, apparently, and brass gives a very low result. As mentioned above, the rule with practical heating and ventilating engineers is to estimate for a liberation of 1.6 to 2 units per degree F. per square foot per hour. In the writer's view, in laying out heating appliances, it will be wise to estimate for the liberation of heat at a rate not exceeding 1.5 B. T. U. per square foot of surface of the radiator exposed, per 1 degree F. difference of temperature, per hour.

It will be easily understood that the above are standard figures, and that for any given increase of temperature desired, say of the air in a room, all that is necessary is to convert the rate of liberation of heat given into increase of temperature of air, and then to divide by the number of degrees by which the air temperature is to be increased. Thus, 1 B. T. U. will raise by 1 degree F. the temperature of about 55 cubic feet of air, if in the neighborhood of 60 degrees F.; or, it will raise the temperature of 11 cubic feet by 5 degrees F., and so on. All that is required to find out what quantity of heating surface is necessary, is to apply the following formula: $S = \frac{C\ (T - T_1)}{55 \times 1.5 \times (T_2 - T_1)}$ where S is the radiating surface in square feet; C is the cubical contents of the room to be heated, in cubic feet; T_1 is the temperature of the air when heat is applied; T that to which it is to be raised; T_2 that of the radiator.

In the above it will be understood that the question of ventilation has not been considered at all. Heating appliances are considered entirely by themselves, and on the supposition that the common practice is followed, of placing the heating apparatus in any convenient position in the cabin, saloon, etc., and irrespective of any mechanically-produced air current; and the heating effect produced by the apparatus is such as would follow on the lines of what would be called natural ventilation. The temperature of the room in which the appliance is fixed is raised to a certain figure by the operation of radiation and convection currents as explained, but without any control having been exercised over the air.

Also, in the above formula the heating up of air only is considered when the room is cold and heat is turned low; but

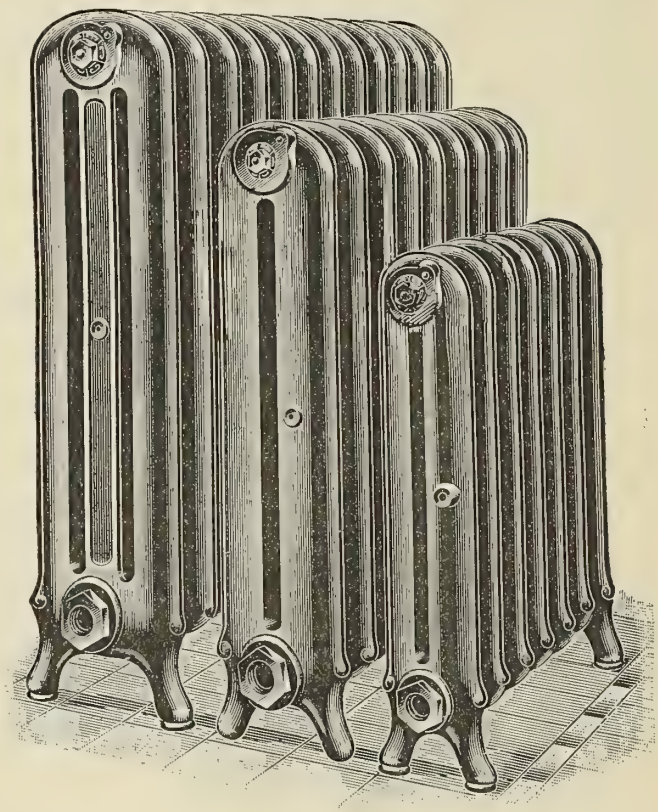


FIG. 9.—DOUBLE-TUBE AND SINGLE-TUBE RADIATORS FOR STEAM OR HOT WATER.

the formula also applies when the room is at its required temperature, and the heating appliance has to make good the heat lost by conduction through the walls of the room, by air currents, etc., if T is taken as the temperature to which the air in the room would otherwise fall in any given time. This is dealt with farther on, when explaining how the heat lost from the room is made up.

Another point that should be mentioned is the effect of the velocity of the flow of water through the pipes. The velocity of the flow of air over radiators, etc., and its effect, will be dealt with when discussing the heating of air, but it may be mentioned that, as is well known to marine engineers, the rate of delivery of heat from a hot-water pipe increases with the velocity of the water, up to a certain figure. The writer believes that experiments have not yet been made with a view of showing what the critical figure is, but, within the limits of ordinary hot-water heating appliances, every increase of the rate of flow tends to increase the heat delivered.

Another point should be mentioned in connection with both

* Cornell University, Ithaca, N. Y.

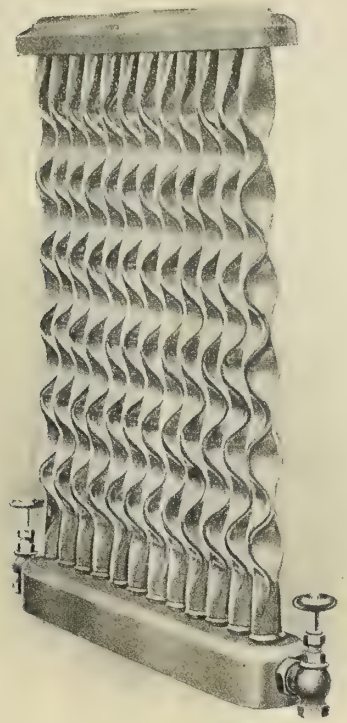


FIG. 10.—ROYLE RADIATOR ON SIR THOMAS LIPTON'S YACHT. ROW'S TUBES GIVE FLEXIBILITY AND LARGER HEATING SURFACE.

steam and hot-water heating. The radiator has been developed because of the necessity of arranging a large surface of pipe within a comparatively small compass, and in such a form that it can be fixed in rooms, etc., without inconvenience. Forms of the radiator are shown in Figs. 9, 10 and 11. As will be seen, the radiator is simply a pipe arranged in a particular manner. A favorite form consists of a number of vertical columns, each column consisting of a single pipe, a loop of pipe, or two, three or four columns; the whole of the columns being held together and standing on feet, raising them a few inches above the floor. The pipes forming the columns are arranged in more or less ornamental form, and their outside surfaces are given the forms shown, in order to present as large a surface as possible to the air which passes through them and over them. As will be explained when dealing with warming air by means of radiators, special arrangements are sometimes made to direct the air over the whole of the surface of the radiator before passing into the room.

The columns of which the radiators are composed are arranged with channels at top and bottom, which, when the columns are assembled together, form pipes for the steam or water, both communicating with the tubular spaces inside the columns. Also, as will be seen from the drawings, it is arranged in nearly all forms of radiators that connection can be made to either end of the channels referred to, at top or bottom, so that the hot water or steam can be brought to either end of the radiator, and where a return connection is made, that also can be taken from either end. This is the usual form, but it will be understood that any design may be arranged that will provide for the connection between the water or steam supply and the radiator, and for the circulation of the steam or water through the individual columns, and for the connection to the return, where there is one.

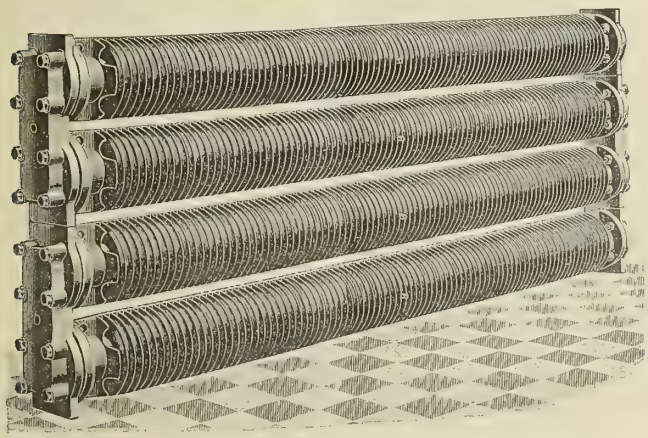


FIG. 11.—KORTING'S RADIATOR FOR STEAM OR HOT WATER, CONSISTING OF PARALLEL HORIZONTAL RIBBED PIPES, CONNECTED TO HEADERS AT EACH END.

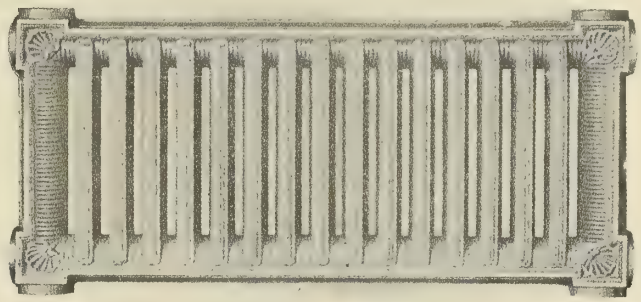


FIG. 12.—RADIATOR FOR HOT WATER OR STEAM. NATIONAL RADIATOR COMPANY.

Radiators are arranged to go into all sorts of confined spaces, such as cabins. Figs. 12 and 13 show the Colonial radiator, made by the National Radiator Company, of Chicago and London, which has been fitted on board H. M. S. *King Edward VII.* It is arranged to be fixed on brackets, secured to bulkheads, at any convenient height, as shown. One method of fixing to walls is shown in Fig. 14. Its great feature is, as will be seen, the fact that it will lie close to a bulkhead, or to the ship's side. It is made in three sizes, respectively, 29, 23 and 16¾ inches long, all 13¼ inches high, and 2⅝ inches deep. When fixed a little way from the bulkhead, the space occupied

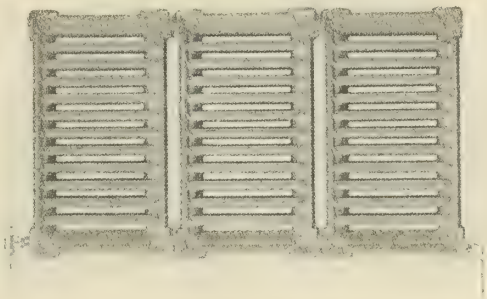


FIG. 13.—BATTERY OF COLONIAL RADIATORS FIXED VERTICALLY.

is very small, and it can be built into any convenient form, several of any size being connected together by right and left-hand threaded nipples, and arranged side by side vertically or horizontally, as may be convenient. Thus, a number of them may be arranged under the seats around the stern of a ship, or in any other situation.

A form of radiator that is a great favorite in hospitals is fitted with hinges at one end, the valves passing through the hinges so that it can be turned back against the wall or brought forward into the room. It appears to the writer that this form would also be useful for cabins and other confined spaces on board ship. It is shown in Fig. 15.

Radiators can be arranged to suit any style of decoration, and practically to fit any space. They may be painted to match the decorations of the cabin or saloon, and they are frequently ornamented in various ways, the castings from which they are formed having an ornamental pattern upon them, the decorative work being afterwards added by artists. In

FIG. 14.—SIDE OF SINGLE-LOOP RADIATOR. NATIONAL RADIATOR COMPANY.

the hot-water radiator it is usual to bring the connection of the supply pipe to the top of the radiator, and that from the return pipe to the bottom. An air cock or valve should be fitted on each radiator at the end, away from the supply service and at the top, and it should be seen that it is always in order. For positions where appearance is not of consequence, as in the forecastle, and in emigrants' quarters, the radiator may take the form of a grid of iron pipes.

There is another system of hot-water heating that has been fixed in some yachts, known as the Reck, which is the invention of a Danish engineer of that name. In this system the heating effect of steam directly injected into a body of water is combined with the effect of the same steam passing around a body of water, on the lines of the feed-water heater. There is a boiler for generating steam, fixed at the lowest part of the system (it would be in the stoke hold on board ship), and a little above the boiler is an apparatus termed by the inventor a "reheater," a device similar to a feed-water heater. At the top of the system is the principal heating apparatus for the water. It is termed by the inventor the "circulator." There is the usual expansion tank above the circulator, and immediately below the circulator is another apparatus called the condenser. Steam is taken directly from the boiler by a pipe to the reheater, where it passes around the pipes, through which the return water from the circulating system is passing, and another pipe is taken from the top of the reheater to a point above the circulator. This pipe is curved around at the top into an inverted U, and is brought into the top of the circulator. From the lower part of the expansion tank a pipe passes to the upper part of the circulator, and a second pipe is also taken from the lower part of the expansion tank along the upper portion of the upper rooms, or the upper deck, to be warmed, and from this the circulating pipes to the radiators are taken. The expansion tank is fitted with a cover; a second pipe passes from its upper part to the condenser, and another pipe from the condenser to the water space of the boiler. The return pipe of the circulator system, which passes along the lower rooms, or the lower deck, to be heated, is connected to the reheater, a second pipe conveying the heater water to the circulator.

The working of the arrangement is as follows: The circulator, being full of water which has returned from heating the radiators, is heated by steam delivered directly from the boiler through the pipe mentioned. When heated, it overflows into the expansion tank and thence to the pipe forming the main flow pipe of the hot-water circulating system. Branch pipes connect the main flow pipe with the return pipe at the bottom, and radiators are connected to these branch pipes in a manner which may be compared to the shunt system in electrical work. The radiators are bridged or shunted across a portion of the vertical pipe. The heated water, having passed down through the vertical pipes and the radiators, returns to the reheater by the return pipe, is there heated by the steam circulating around the pipes through which the water is passed, and thence again commences its outward journey, passing up the pipe to the circulator, where it is further heated by steam, and so on.

The condenser is similar to the usual surface condenser, with which marine engineers are familiar. It consists of the ordinary cylinder, with a series of tubes, arranged either in a vertical or horizontal position as may be convenient. This device condenses the steam which is delivered in the circulator, but which is not fully employed in heating the water for the circulation system, and which finds its way through the pipe into the expansion tank, and thence rising in bubbles, in the well-known manner, passes out of the top of the expansion tank by the pipe leading to the condenser. It is condensed by the flow of the water coming from the reheater,

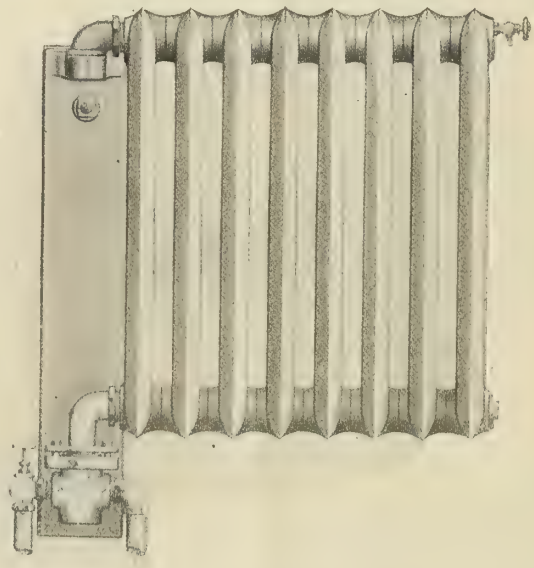


FIG. 15.—SWINGING RADIATOR OF NATIONAL RADIATOR COMPANY. THE VALVES ARE IN THE HINGES.

the condensed water being carried off by a pipe to the water-space in the boiler.

It will be noticed that the water receives heat from the steam at three places; in the circulator itself by direct contact, in the reheater and in the condenser. Further, the delivery of steam from the circulator into the closed expansion tank, by setting up a certain pressure above the water in the expansion tank, causes the water to run freely in the circulating system, quite apart from the circulation caused by difference of temperature, etc. The water-supply service is usually connected to the expansion tank with a ball cock, in

the usual way, cold water being added to the system when required and passing directly into it.

The advantage claimed for the Reck system is, that heat will be got up very much more quickly by its aid than with the ordinary system of hot-water service that has been explained. On the other hand, it is rather more complicated than the simple hot-water system, but the apparatus of which it is composed should present no difficulty to marine engineers. The main source of heat is usually a boiler on shore, and, in places where there is no other steam supply, can, of course, be steam from the ship's boilers, or the exhaust steam from the engines or auxiliaries, or any other convenient source.

(To be Continued.)

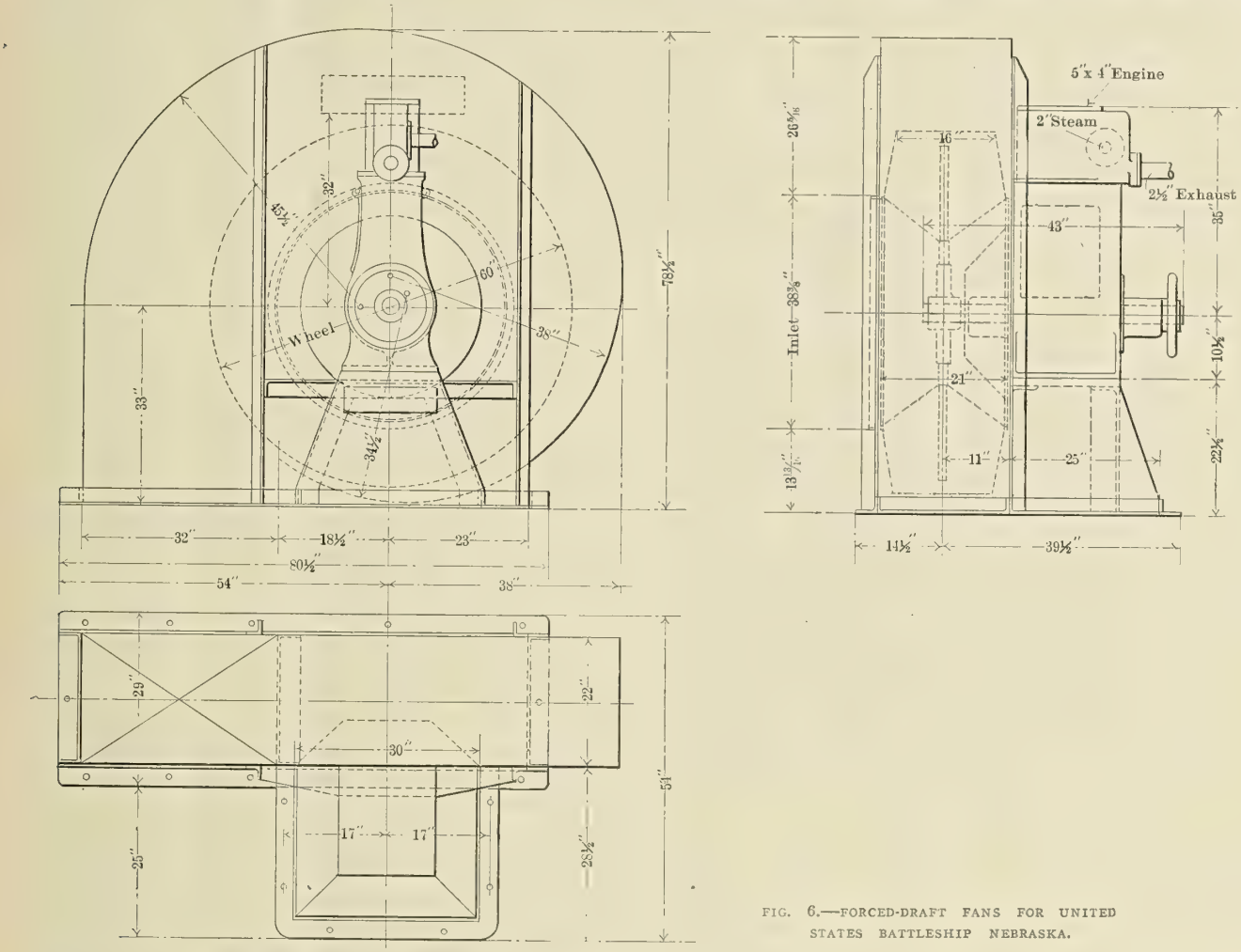


FIG. 6.—FORCED-DRAFT FANS FOR UNITED STATES BATTLESHIP NEBRASKA.

MECHANICAL DRAFT IN MARINE PRACTICE.

BY WALTER B. SNOW.

(Concluded.)

Although the term forced draft has been generally employed to distinguish artificial from so-called natural draft, yet, properly speaking, it should be denominated mechanical draft. The reason is evident in the fact that the two methods of artificial draft production are now classified as the forced and the induced, or more properly the plenum and the vacuum methods. Although both were experimented upon by Stevens in 1827 and in the succeeding years, yet the former remained for a long period practically the only form in which mechanical draft was applied. As the term implies, the air under the plenum method is forced through the fire; that is, the pressure maintained below the fire is greater than that of the atmosphere. Hence, the general term "forced" draft.

Under the plenum method the air may be supplied in either of two ways: First, by making the ashpit practically air tight, and then forcing into it the air in sufficient quantity and under the requisite pressure. Evidently, the only escape for the air being through the fuel, it must all be utilized for the purposes of combustion. Second, by making the fireroom itself practically air tight, and maintaining therein the required air pressure by means of a fan of sufficient capacity to constantly make good the amount of air which, under pressure, passes to the ashpits and thence through the fuel.

Under the vacuum method there is practically only one means of application—that by the introduction of an exhausting fan in the place of a chimney. This is commonly known as the "induced" or "suction" method. The fan thus serves to maintain the vacuum which would exist if a chimney were employed, and its capacity can be made such as to handle the gases which result from the process of combustion. A short and comparatively light stack usually serves to carry these gases sufficiently high to permit of their harmless escape to the atmosphere.

Evidently, the method of application to be adopted must depend upon the circumstances. It cannot be said that under all conditions any one of these three principal methods, or their numerous modifications, is superior to the others. A combination of both the forced and the induced methods, if properly controlled, may give almost ideal results.

The closed ashpit system was naturally first applied, because of its ready adaptability to existing conditions. But unless special arrangements are provided, the air may be improperly distributed in the ashpit, and with intense draft, holes be blown through the fire, and the grate bars thus

overheated wherever the draft is concentrated. The pressure within the ashpit and the furnace chamber causes all leakage to be outward. The tendency is, therefore, to blow the ashes out of the ashpit and the flame, smoke and fuel out of the fire doors, but with slight effect in the case of stationary boilers at moderate rates of combustion. In the marine service inconvenience from this source is avoided by fitting the boilers with false fronts, within which the air pressure is maintained. By a proper arrangement of double doors and dampers, the disadvantage and danger from flame is completely overcome. The mere arrangement of dampers so connected to the doors that they close when the fi e doors are opened is of great advantage. The false front further presents an excellent, yet simple, means of admitting air above the fuel, a feature which enters into most arrangements of this character. The conditions which have to be met in some cases of marine practice are exemplified in Table V., in which are presented the results of three tests of the air pressures produced by fans on the old U. S. S. *Swatara*, which was equipped with Kafer's closed ashpit system.

Table No. VI.—Saving by Forced Draft on S. S. *Dania*.

Conditions, Four Voyages Each.	Days Steaming.	Knots.	Consumption of Coal per Day	
			Propulsion.	For all Purposes.
Natural draft.....	17.00	7.50	9.73	10.70
Forced draft.....	16.21	7.58	7.76	9.31

Table VII.—Temperatures in Tubes of Marine Boiler.

Location, from combustion chamber	Temperature	Location, from combustion chamber	Temperature
1 in.	1,466	1 ft. 2 in.	1,368
2 in.	1,426	1 ft. 8 in.	1,295
3 in.	1,405	2 ft. 8 in.	1,198
4 in.	1,412	3 ft. 8 in.	1,106
5 in.	1,398	4 ft. 8 in.	1,015
6 in.	1,406	5 ft. 8 in.	926
7 in.	1,400	6 ft. 8 in.	887
8 in.	1,410	In smoke box	782

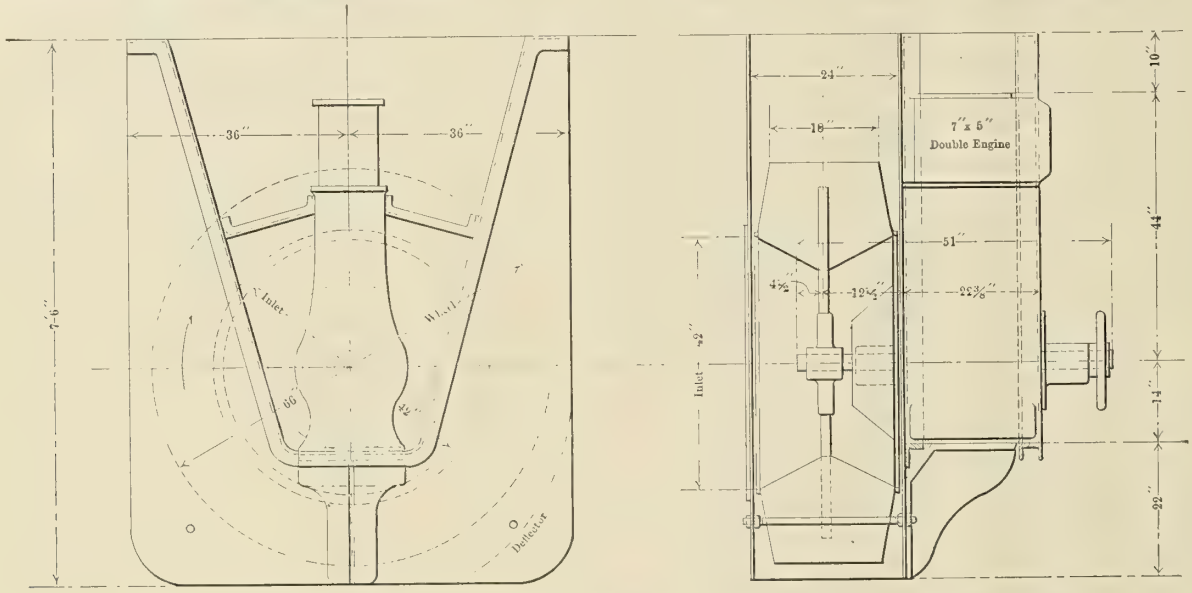


FIG. 7.—FIRE-ROOM BLOWERS FOR UNITED STATES CRUISER CHICAGO; 66-INCH FAN WITH DOUBLE ENGINE.

Table No. V.—Air Pressures in Connection with Boilers of U. S. S. *Swatara*.

Air pressure in conduit.....	2.87	4.76	3.48
Air pressure in ashpit.....	2.08	4.01	2.34
Air pressure in furnace door frame.	1.86	3.61	2.13
Air pressure in furnace.....	1.63	3.18	1.75
Air pressure in uptake.....	0.13	0.10	0.07
Revolutions of fan per minute.....	438.6	584.8	476.6

The practical results of the introduction of the closed ashpit system in place of natural draft are clearly shown in the record (Table VI.) of four voyages of the steamship *Dania* under each of these conditions. The total consumption of coal per day was reduced 13 percent, while the time occupied in making the voyage was decreased nearly 5 percent. This method of application also presents an opportunity which it shares in general with the induced draft system, and in some degree with the closed fire-room system, for utilizing the heat of the waste gases.

The variation in the rate of absorption of heat from the gases, which takes place in their passage through the tubes of a Scotch type marine boiler, is clearly shown (Table VII.) by the results of tests of a boiler worked at its normal capacity, the rate of combustion of coal being relatively low—only 17 pounds per square foot of grate per hour. The temperature existing in the combustion chamber was 1,644°, and that just inside the tube, 1,550°. Experiments with one of the Babcock & Wilcox watertube boilers of the *Cincinnati* showed a temperature of escaping gases ranging from 466° to 640°, with corresponding rates of combustion of 19.61 and 50.38 pounds of coal per square foot of grate per hour. These results all point to a wastefulness which may be reduced by introducing additional devices to abstract a larger proportion of the heat from the gases.

Simplest among such devices for fire-tube boilers are to be classed the Serve tube and the retarder. The former consists of a number of radiating ribs extending the full length of the interior of the tube, and presenting extra surface for the absorption of heat. The latter is a helically twisted strip of sheet iron of long pitch, inserted in the tube, which breaks up the current of gas and forces all portions of its volume into touch with the inner surface of the tube. The influence of these retarders in the case of a 100-horsepower boiler is shown in Table VIII. With the rapidly increasing use of the watertube type of boiler, the economic opportunity for the retarder is rapidly vanishing.

In other systems which have been extensively introduced in connection with marine boilers, tubes are interposed in the uptake. Through these the gases pass while the air is forced or drawn across them and down through a false front

Table VIII.—Reduction in Temperature of Flue Gases and in Coal Consumption by the Use of Retarders.

Horsepower Developed	Reduction in Temperature of Flue Gases Degrees Fahr.	Reduction in Coal Consumption Percent.
52	20	0.0
75	53	0.0
100	32	3.2
125	46	4.0
150	19	3.3
170	59	3.6
200	36	4.1
225	26	8.6
239	123	18.4

to the ashpits. A suitable arrangement of doors and dampers provides for partial admission above the fire, and for opening and closing the doors without objectionable results.

The adoption of the closed fire-room system, in which a plenum condition is maintained in a practically air-tight fire-room, is largely the result of conditions. It lends itself admirably to the necessities of vessels in actual warfare, for it is essential that the openings down to the engine and boiler rooms should be kept as small as possible; and in all cases the machinery department would be closed down and the air supplied by artificial means during an engagement. In a war vessel with protective deck and minute watertight subdivisions it is extremely difficult where there is a large number of boilers to so arrange the blowers for closed ashpit draft as to ventilate the fire-room thoroughly. Fans installed upon the closed fire-room principle can be easily arranged to ventilate the engine and fire-rooms as well as to increase the combustion rate. They thus perform a double duty, and avoid the use of a second set, were this arrangement inadmissible.

The conditions existing in the naval marine are, however, decidedly different from those in the merchant service. The absence of the protective deck, the opportunity for open fire-rooms and the greater space which is usually available, generally make possible the closed ashpit system in the merchant marine, and thereby insure clean and comfortable fire-rooms. In the case of the warship, its maximum steaming capacity is seldom demanded, and then only for a comparatively short time, as during an engagement. By the employment of mechanical draft it is possible to construct the machinery within the limits of space and weight which are sufficient for ordinary service, while the reserve of power is stored in the light fans and fittings, instead of in the cumbrous boilers and machinery. In this fact is summarized one of the most important advantages of mechanical draft for marine purposes.

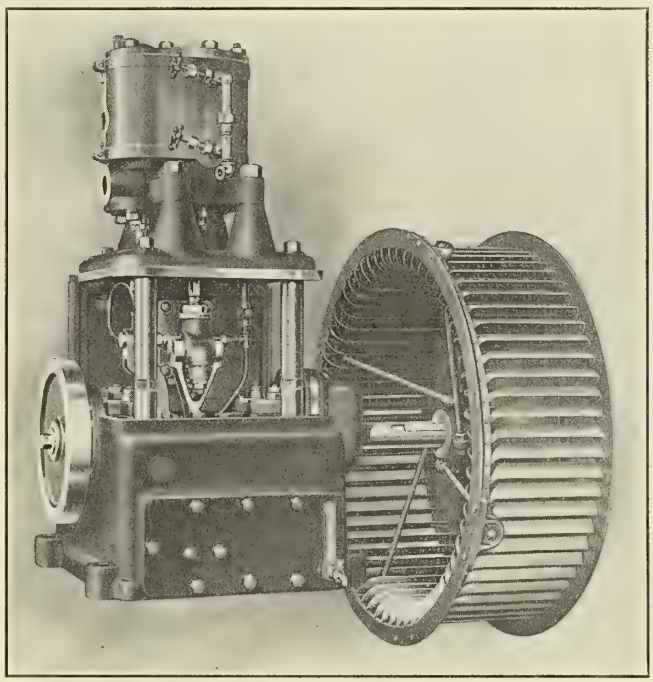
Under ordinary cruising conditions, where the stacks are of moderate height, the fans may not be required, but they must be of form, construction and capacity sufficient to meet at an instant's notice the maximum demand that may be made upon them. For instance, a vessel of the cruiser type, which may be required in case of necessity to develop 9,000 to 10,000 horsepower, may at the usual cruising speed of 10 or 12 knots require only 1,500 to 2,000 horsepower. These conditions are well exemplified by the results in Table IX. of a series of tests of the late U. S. S. *Charleston* at various rates of speed. The rapidly increasing horsepower with increased speed is to be noted, as is also the far more rapid increase in the power of the blowers, made necessary to meet the requirements. The relation between the actual efficiency, as is shown in the coal per indicated horsepower and the nautical miles per ton of coal, is of interest as indicating the difficulties in the way of obtaining even a slight increase of speed when it is well up to the maximum.

Table IX.—Results of Tests of U. S. S. *Charleston*

Speed in Knots.	13	14	15	16	17	18
I. H. P. main engines.....	2,220	2,820	3,550	4,370	5,220	6,120
Coal per I. H. P. per hour.....	2.2	2.1	2.0	1.9	2.1	2.5
I. H. P. of blowers.....	0.0	2.5	6.4	17.6	36.8	69.6
Nautical miles per ton of coal..	4.34	4.00	3.68	3.41	2.84	2.22

The fans first employed with the closed fire-room system were frequently of the inclosed type, often from necessity, because the fan was placed outside the fire-room. This type, shown in Fig. 6, has gradually given way to a form of construction employed in fans suspended overhead in the fire-room, in which the rim or roundabout is partially or entirely discarded, although direct contact with the rapidly revolving wheel is prevented by an arrangement of wire netting. This construction is shown in Fig. 7.

Among the advantages of the closed fire-room system is that of preventing all escape of flame and smoke into the fire-room; the leakage being all inward to the fires. This feature is preserved in some recent equipments in which stack



THIRTY-INCH SIROCCO BLOWER ON STEAM YACHT VIRGINIA, DIRECT CONNECTED TO A 5 BY 3-INCH FORBES ENGINE.

heaters are provided without direct connection to the blowers. The pressure within the fire-room is, however, sufficient to cause a flow of air between the tubes through which the hot gases pass, and thence down through false fronts to the ashpits as well as to openings above the fire. Pressures in fire-room and ashpits are thereby balanced.

The induced system, whereby a partial vacuum is produced within the furnace, is substantially the same in its effect as a chimney, which it most closely imitates in its action. Its leakage is always inward, avoiding inconvenience from flame and smoke at the fire-doors. On shipboard it produces excellent ventilation with open fire-rooms, thereby reducing their temperature. It is cleanly, lends itself readily to control by the dampers which may be introduced for the purpose, and can by simple means be rendered absolutely automatic, requiring no attention whatever from the fireman.

The early objection to this system, before it had been extensively adopted, was that the fans could not stand the high temperature of the gases passing through them. The best refutation of this statement lies in the fact that large numbers of fans have been running for years under these conditions, handling gases from 500° to 800° in temperature. Of course, these fans require to be of special construction to

withstand the heat, and must be provided with means for keeping the bearings cool. But these features were long ago introduced, and to-day the decision between a forced or an induced system is to be made independently of the question of durability of the fans.

The induced system presents an excellent opportunity for the introduction of air or water heaters which are to abstract the heat from the waste gases, thereby securing one of the greatest possible economies in the modern boiler plant, be it on land or sea. The reduction in temperature which may be thus secured not only increases the efficiency of the plant, but has an appreciable effect upon the proportions of the fan; for upon the temperature of the air and gases which pass through the fan must depend its size and speed to accomplish the desired results in the way of draft production.

Under the plenum or forced system, the volume of air supplied to the fire is substantially the same as that delivered by the fan, making no allowance for leakage. But with induced draft the fan must handle a volume of air and gases which, although the same in weight, is greater in volume practically in proportion to its increase in absolute temperature. Disregarding leakage, the weight is greater than the air admitted, by that portion of the coal which has entered into chemical combination with it. On a basis of 18 pounds of air per pound of coal, this additional weight amounts to 5.5 percent, while with a supply of 24 pounds it is 4.2 percent. This increased amount may enter into any refined calculations of fan capacity, but it is unnecessary to go into the detail of making allowance for difference in specific gravity, or for moisture in the air or fuel.

As the capacity of a fan, both in volume handled and pressure produced, is easily varied by a change in speed, sufficient accuracy is secured in ordinary design by considering that air is the fluid handled, and that the volume is proportional to the absolute temperature.

Not many years since it was asserted by a well-known authority that "ten years ago one ton of cargo was carried 100 miles for 10 pounds of fuel. Now—with the great increase in size of ships and other mechanical improvements—the same work is done for about 4 pounds of coal." And still there remains room for further improvement.

The German Navy.

Beginning with an act of the Reichstag in 1898, Germany has been working on a definite program, worked out for several years in advance, in connection with the enlargement of the navy. Three times since the act of 1898 there have been enlargements in the program, and there seems to be now a strong sentiment in favor of placing the German navy upon a very high plane of power and efficiency.

The act of 1898 contemplated the construction within a few years of twenty battleships, eight coast defenders, twelve large and twenty-nine small cruisers, besides six destroyers to be laid down annually. A number of these ships were already in being, and the program called for the construction of two or three large ships every year to complete the total number. The act of 1900 increased the battleships to thirty-eight, the large cruisers to fourteen and the small cruisers to thirty-eight. The act of 1906 increased the large cruisers to twenty and doubled the number of destroyers, requiring twelve to be laid down each year. The act of 1907 decreased the active life of all vessels from the twenty-five years contemplated in previous programs to twenty years, thereby automatically increasing the amount of new construction to take the place of vessels passed into the reserve.

The program of 1908 calls for a still further increase, it being estimated that during the next three years there will be built each year three battleships and one armored cruiser, the idea being that by the end of 1914 Germany will have completed a fleet of sixteen battleships of the *Dreadnought* type and five vessels of the *Invincible* type. Six years later it is expected that there will be a total of forty-seven battleships and twenty armored cruisers, of which thirty-two battleships will be larger than the British *Dreadnought*. It is thus the aim of Germany to stand second to England, displacing the United States from this position.

SCOTCH SHIPBUILDING IN 1907.

BY BENJAMIN TAYLOR.

The year 1906 was a record one in shipbuilding, and its output exceeded that of all its predecessors. It cannot be said that the output of 1907 exceeded that of 1906 in all the United Kingdom, but it did in Scotland, which thus again stands foremost in all the shipbuilding centers of the world. Drawing together the figures for the whole kingdom as collected (and I take the figures compiled by *The Glasgow Herald,* knowing that they are very carefully revised) we have the British total as 1,825 vessels, 1,814,961 tons and 1,776,768 indicated horsepower; a decrease on the year of 187,610 tons and 69,235 horsepower. The number of vessels increased by 454, owing to the many small vessels built. The table summarizes the work of the year:

	1907,			1906,		
	Ships.	Tons.	I. H. P.	Ships.	Tons.	I. H. P.
Scotland	757	675,173	742,299	511	658,830	670,431
England	1,030	1,001,246	952,239	832	1,193,881	1,028,352
Ireland	38	138,542	82,230	28	149,860	147,220
Totals	1,825	1,814,961	1,776,768	1,371	2,002,571	1,846,003

The foreign returns so far show that 1,509 vessels were built, aggregating 1,432,589 tons and 1,335,458 indicated horsepower, as against 1,344,715 tons and 1,318,345 indicated horsepower in 1906. From the British colonies, returns have come of 189 vessels of 36,344 tons and 14,023 horsepower launched in 1907, as against 109 vessels, 28,272 tons and 18,395 horsepower in 1906. This gives an approximate world total for 1907 of 3,523 new vessels put into the water, of 3,277,894 tons and 3,127,149 horsepower, as compared with 2,757 vessels, 3,375,958 tons and 3,182,744 horsepower in 1906.

To come now to Scotland, the large numbers of trawlers and drifters built last year increased the number of vessels considerably. The table shows the work done in the Scottish shipyards:

	1907,			1906,		
District.	Ships.	Tons.	I. H. P.	Ships.	Tons.	I. H. P.
Clyde	526	619,919	668,527	372	598,841	606,600
Forth	58	21,370	23,342	39	17,120	13,825
Tay, etc.	39	17,672	30,395	27	30,440	31,372
Dee and Moray Firth	134	16,212	20,035	73	12,429	18,634
Total	757	675,173	742,299	511	658,830	670,431

That the Scotch output should exhibit an increase when everybody expected, and all the rest of the country experienced, a decrease, must be attributed to the wonderful versatility of the Clyde shipbuilders, who turn out every description of floating craft, from the biggest of battleships to the smallest of barges. The total tonnage has been materially increased by the large number of fishing steamers and other small craft that were built, though there were large vessels also.

The leading firm in 1907 was Messrs. Russell & Company, Port Glasgow, with a tonnage larger than they had in 1906; and the Fairfield Company, Barclay, Curle & Co., Wm. Hamilton & Co., and Alex. Stephen & Sons follow, in the order given. The following is a summary of the returns of the Clyde builders:

	1907, Ships.	1907, Tons.	1907, I. H. P.	1906, Tons.	1906. I. H. P.
Russell & Co.	14	71,705	.....	63,338	.....
The Fairfield Company	6	48,020	112,000	20,063	29,380
Barclay, Curle & Co.	6	47,362	40,532	33,698	25,310
Wm. Hamilton & Co.	10	44,305	.....	35,369	.....
Alex. Stephen & Sons	9	44,094	35,930	22,982	18,700
Charles Connell & Co.	9	40,298	.....	31,106	.....
D. & W. Henderson & Co.	17	35,886	30,300	33,187	23,950
John Brown & Co.	7	35,293	73,000	46,387	108,900
Wm. Denny & Bros.	20	34,418	63,200	40,632	44,200
A. Rodger & Co.	8	22,674	13,775	19,895	8,300
Archd. McMillan & Son	8	21,918	.....	23,276	.....
Scott's Shipbuilding Co.	10	20,916	11,700	33,180	50,100
Napier & Miller	7	19,785	.....	10,740	.....
Green'k & Grangem'h Co.	8	16,337	.....	22,112	.....
Wm. Beardmore & Co.	3	14,500	11,000	21,000	4,000
Clyde Shipbuilding Co.	6	10,981	12,600	11,096	10,800
Ailsa Shipbuilding Co.	22	10,778	8,000	9,368	.....
Murdoch & Murray	7	6,850	.....	2,559	.....
Caird & Co.	1	6,437	7,700	26,778	17,000
Fleming & Ferguson	16	6,153	9,100	5,601	8,300
Ross, Duncan & Co.	2	5,981	10,735	10,710	11,635
Lobnitz & Co.	26	5,772	6,760	4,539	6,195
London & Glasgow Co.	1	5,580	5,300	13,154	13,100
*David Rowan & Co.	..	.....	50,220	.....	45,850
*Rankin & Blackmore	..	.....	29,250	.....	23,200
*Dunsmuir & Jackson	..	.....	26,250	.....	41,325
*John G. Kincaid & Co.	..	.....	22,750	.....	18,000
*W. V. V. Lidgerwood	..	.....	16,540	.....	14,365
*Muir & Houston	..	.....	10,470	.....	11,200
All others	299	43,906	61,415	58,161	72,790

* Built machinery only.

The total number of vessels was 199 sail and 327 steam.

An increase of 61,927 indicated horsepower in the marine engineering output of the Clyde is explained by the Fairfield Company, which firm alone has an increase of 82,620 horsepower. John Brown & Company, first in 1906, with 108,900 horsepower (which included the turbines of the *Lusitania*), are second in 1907 with 73,000 horsepower; Denny & Company, third, with 63,200; Rowan & Company, fourth, with 50,220, and Barclay, Curle & Company, fifth, with 40,532 horsepower. In the work of the Fairfield Company were included the turbines for H. M. S. *Indomitable** and *Bellerophon*,† and the two Mediterranean steamers *Heliopolis*‡ and *Cairo;* in that of John Brown & Company, the turbines for H. M. S. *Inflexible*,* the Harwich-Holland boat *Copenhagen,* and the Fishguard-Rossclare boat *St. Andrew.* Denny & Company constructed turbines for half a dozen vessels.

Twelve years ago the highest Clyde ship output was under 400,000 tons. In 1896 the industry began an upward movement, which has continued until now. In 1901 the half million point was reached, and now the total is over 600,000 tons. The increase alone represents the entire production of an average shipbuilding district. Such a rate of advance as the river has experienced cannot continue forever, and it is just a question of whether the stopping place has now been reached. Twelve months ago it was thought that it had arrived. There was a record output for 1906, and trade was obviously on the decline. But the Clyde has wonderful ability for turning out unexpected tonnage never heard of in the way of contracts, such as barges, lighters, pontoons and other craft shipped abroad in parts, which do not figure in the books of the registry societies. They are not measured by the Board of Trade, but yet they represent a large amount of shipbuilding material and shipyard labor. With these contrast the big cruisers at Fairfield and Clydebank, two big Mediterranean turbiners at Fairfield, two Allan liners at Linthouse and Whiteinch, and three Pacific steamers at Beardmore's Dalmuir. There was also more tonnage of dredging craft produced at Renfrew, Paisley and Port Glasgow. There was no large vessel in the list at all approaching the *Lusitania*** in tonnage, but, in spite of this, the total breaks the record of 1906, in consequence of the variety of work done on the river. The high total is wholly made up of ordinary everyday vessels—cargo steamers most of them, with, as already indicated, an unusually large proportion of vessels of the barge, lighter and fishery types.

The different types of vessels represented in 1907 were: Screw steamers, 192; barges, etc., 186; fishing craft, 31; dredging plants, 29; sailing yachts, 25; launches, etc., 24; tugs, 13; turbine steamers, 9; stern-wheel steamers, 6; warships, 3; steam yachts, 2; barque, 1; motor vessel, 1; turbine yacht, 1; railway ferry, 1; cross-river ferry, 1; motor yacht. 1.

Among the "screw steamers" were the Allan liners *Corsican*,† *Grampian* and *Hesperian*—the first of 11,637 tons, and the other two of 10,000 tons each. The turbine steamers were the Mediterranean liners *Heliopolis* and *Cairo,* built at Fairfield, five vessels at Dumbarton—two for the South Eastern & Chatham Railway Company, two for the Nippon Petsudo Kwaisha, of Tokio, and one for the Union Steamship Company, of New Zealand; and two vessels built at Clydebank—one for the Great Eastern Railway Company's Harwich and Hook of Holland route, and the other for the Fishguard-Rossclare service. There were also King Edward's new turbine yacht at Pointhouse, and the turbine cruisers *Indomitable* and *Inflexible* at Fairfield and Clydebank, respectively. One sailing barque, the *Rendova,* figures in the returns; one large motor vessel, the *Scout,* at Troon; and one railway ferry, the *Lucia,* at Whiteinch.

Only one merchant sailing ship! And thirty years ago there were 104 firms in Glasgow and Greenock registered as owners of iron sailing ships. Of these, 74 have disappeared, 13 are still sailing-ship owners, 8 have abandoned sailing tonnage for steam, 6 are now in other lines of business, and three now own steam as well as sail tonnage. To these have to be added 28 new firms, the total now standing at 41. In 1887 the sail tonnage owned in Glasgow aggregated 411,970 tons; to-day it is only 316,102 tons. In 1877 the average size of each sailing fleet was 3,960 tons, against 7,710 to-day; while the average size of the ships was 1,135 tons, against 1,860 this year.

There are on the Clyde about fifty shipbuilding firms, ranging from the builders of small launches and yachts up to builders of great liners and mighty cruisers and battleships. The only type of vessel not represented in 1907 on the Clyde is the large turret, trunk or cantilever steamer, which figures so largely in the work of the northeast of England yards. Variety of work has always been a feature of Clyde shipbuilding, and the district therefore often keeps busy after a falling off in other districts. A "slump" in cargo steamers hits all the northeast coast hard, but the many special vessels on the Clyde—liners, warships, dredgers, vessels for export in parts, and yachts—keep the yards here employed for a considerable time after they have ceased to book cargo steamers. This is why the 1907 tonnage exceeds even that of 1906, though the year closes with very poor prospects. There has never been a year in which so many small vessels have been built on the river; trawlers and steam drifters for deep-sea fishing; launches, barges, lighters, pontoons, steam ferries, shallow-draft steamers for river services abroad, tugs and tenders for service at foreign ports, and steamers built in section, shipped to other countries, and then transported and rebuilt on inland lakes.

The year closed with many workmen idle and many yards empty, particularly yards where first-class liners are built, and yards which depend on "tramp" steamers. The builders who do miscellaneous work are partly able to keep their staffs together, but most of the big yards have paid off large numbers of men each week for some months back. There is no demand for cargo steamers, and builders are prevented by the high price of material and labor from tendering low enough to obtain orders. Many of the orders booked recently have been at below cost prices, taken to keep establishments going in hope of better times. When wages come down after the

* International Marine Engineering, May, 1907, p. 200.
† January, 1908, p. 42.
‡ January, 1908, p. 1.
** International Marine Engineering, August, 1906, p. 291; May, 1907, p. 202; June, 1907, p. 230; September, 1907, p. 382; October, 1907, p. 389.

† October, 1907, p. 424.

new year, if there is also a further reduction in the price of shipbuilding materials, the position may improve a little; but the situation is doubtful, until the trade of the world recovers and there is more money for investment in new ships. The outlook is bad, and it is practically certain that the tonnage output for 1908 will show a very considerable decrease. The cause is said to be, partially at least, overproduction during the past three years.

It is evident that the dullness prevalent all over this district will continue well into this year. There is an exceptionally large number of vacant berths, and the total tonnage on hand is lower than it has been for a long time, and is very irregularly distributed. A few yards are well employed, while others are practically and some absolutely idle. The Fairfield and Clydebank Companies are completing the battle cruisers *Indomitable* and *Inflexible;* but on the stocks at Fairfield there are only two small steamers (one for the Canadian Pacific Railway Company, and one for service in the East), and at Clydebank the shipyard berths are all vacant. At Dalmuir (Beardmore's) the only vessel in course of construction is the last of four steamers for the Pacific Steam Navigation Company. These three yards employ, normally, from 15,000 to 20,000 workers, but at present they are finding work for only a few hundred.

The London & Glasgow Shipbuilding Company has been idle for a considerable time, and D. & W. Henderson & Co., Partick, who usually have their yard well filled, have only two vessels on the stocks, one of them for the Anchor Line's Eastern trade. John Reid & Co., Whiteinch, have very little work on hand, while Napier & Miller have only an oil-tanker for the Anglo-American Oil Company and a cargo steamer for home owners. At Renfrew, Lobnitz & Co. have three vessels on the stocks, one a large dredger and the others smaller vessels; while Simons & Co. have also three vessels in course of construction. Charles Connell & Co. have six steamers at different stages of construction; Barclay, Curle & Co., three large vessels; and Alex. Stephen & Sons, who have just launched the new Allan liner *Hesperian,* have several vessels on the stocks and on order. Yarrow & Co. have four torpedo boats building, in their new yard at Scotstoun, for the Brazilian government, and six others to lay down, and they are also building two motor boats for the Austrian government. A. & J. Inglis, Pointhouse, are completing the new yacht for King Edward, and building a large steam yacht for an American owner, a steamer for G. & J. Burns, and a railway ferry for the Entre Rios Railway Company, similar to the *Lucia Carbo,* completed last year. They have also two large paddle steamers to lay down for South American owners. Mackie & Thomson have nine fishery steamers on the stocks, for North of Scotland owners.

Dumbarton has had steady work for about ten years, but at present fares no better than the other parts of the river. In Denny & Brothers' yard the work on hand includes two torpedo-boat destroyers for the British government, a large trading steamer, and a variety of light-draft vessels for shipment abroad. McMillan & Co. have two large cargo steamers on the stocks. At Greenock the condition of trade is unsatisfactory, and in only one of the yards are the prospects good. This is Caird & Co.'s, where three vessels are building for the Peninsular & Oriental Company—two large passenger liners and an express mail boat for the Bombay and Aden service. These vessels should keep the yard employed for a year. Scott's Shipbuilding & Engineering Company has on the stocks only one vessel (a twin-screw yacht). The Greenock & Grangemouth Shipbuilding Company, after launching a vessel of 3,500 tons, has only an oil-steamer contract, secured recently.

While one or two of the Port-Glasgow firms have a good amount of work, the outlook all around is anything but bright. D. J. Dunlop & Co. have one vessel in course of construction, while an order for another has been secured from a Hong Kong firm. In the yard of Russell & Co. there are seven large steamers nearing completion. William Hamilton & Co. have one steamer almost ready and another in progress, while the keel will shortly be laid of a vessel for Amsterdam owners. Murdoch & Murray have one steamer for a Glasgow firm. Ferguson Brothers, who have had a busy year, have still four—a dredger-tender for the Thames Conservancy Board, a ferryboat for the Clyde Navigation Trust, a bucket-dredger for India, and a tug for service on the West coast of Africa. In the yard of the Clyde Shipbuilding & Engineering Company there is one vessel under construction, and A. Rodger & Co. have only one, which is ready for launching. In Paisley, John Fullerton & Co. are practically idle, but Fleming & Ferguson start the year with three small vessels under construction. Bow, McLachlan & Co. will also have a fairly good year. The Ailsa Shipbuilding Co. has a steamer of about 2,000 tons building at Troon, and is constructing three steel barges for shipment to South America, and a small coasting steamer. The work at Ayr yard includes a steamer of 900 tons for British Columbia, a steamer of 475 tons for the Glasgow coasting trade, and six barges for Brazil. The Campbeltown Company is building two vessels of about 9,000 tons. The building of motor boats is coming to be an important industry, and quite a number of firms are now specializing in this type of craft. The total tonnage of new work on hand at the beginning of 1908 was 315,000 tons, as compared with 410,000 at the beginning of 1907.

Of the total tonnage built in the world during 1907, 60 percent was built in the United Kingdom; 42 percent was for owners in the United Kingdom and British colonies; 18 percent represented work done by British builders for foreign owners. In 1906 the work done in the United Kingdom for foreign owners was much less—11 per cent; and in that year the proportion of the world's tonnage produced by British yards was 66 percent. The output of the United Kingdom, with all warships and all merchant ships of less than 1,000 tons excluded, was a quarter of a million tons less than in 1906, although the tonnage built for foreign owners was 150,000 tons more. The increase in the foreign tonnage was due largely to the development of the emigrant trade between the Mediterranean and America. All the Italian ships built here were for this trade, as were the greater number of those built for Austria and several for France. French owners bought several vessels that were building for British owners, because native builders could not give quick enough delivery. South American firms have built largely in this country. The Lloyd Brazileiro, of Rio de Janeiro, was the principal customer from that quarter. The Tyne and the Wear both produced more tonnage for foreign owners than the Clyde. The extent of the Clyde total tonnage built for foreign account was 105,867 tons; that of the Tyne, 111,201 tons; that of the Wear, 112,522; and on the Tees, 78,840 tons. Germany produced 258,649 tons, and had built 46,555 tons in the United Kingdom. France produced 70,513 tons, and had built 48,613 tons in the United Kingdom. Japan produced 52,214 tons, and had built 12,790 tons in the United Kingdom.

In 1907, Britain launched six vessels of over 10,000 tons, as compared with three launched elsewhere; and of vessels between 8,000 and 10,000 tons launched twelve, as compared with seven launched elsewhere.

As to the work of the year, there was no *Lusitania* in 1907. The coasting and cross-channel steamer is a familiar product of the Clyde, and in size, arrangement, and structure has shown comparatively little variation for years, as their trade requirements have varied not so much in character as in quantity. There has, however, been an advance in the internal economy of these vessels in recent years, in removing obstructions in the holds and in special arrangements to dispense with

stanchions in the way of the hatchways. Every request of owners for provision of facilities for rapid handling of cargo has been quickly met. In the latest examples of these steamers there are no stanchions whatever, and no webs or other structural obstructions in holds or between decks. Improvements have also been carried out in the general design of the vessels of this type, which can now not only handle cargoes more rapidly and cheaply, but carry them more safely and more free from damage than in former years.

In the building of ocean cargo steamers there has been much development of recent years. The turret ship, which dates from 1892, is distinguished by its complete departure from previous standards of sea-going cargo steamships. The turret ship has no sheer, and the central turret erection makes it a self-trimmer, while the disposition of the material provides stiffness to resist both vertical and horizontal bending stresses. These ships are usually built with no deck below the turret deck. The ship is kept in shape by an open framework, at intervals of about 27 feet, consisting of two vertical and two horizontal members, so that if the continuation from the rounded base of the turret to the round-over of the side plating is part of the shell structure, they are single-deck ships. Their internal structure has recently been developed by leaving the holds free from cross-beams, and by combinations on the principle that the most economical disposition of material in a box-shaped girder should be that which places it chiefly on the external walls. Doxford & Sons, Sunderland, the patentees, have built 174 turrets, representing 663,701 tons.

The turret steamer stimulated builders and owners to other departures from conservative designs. There was a change of view as to the number of decks for a cargo steamer. A deck below the upper deck is desirable for dividing cargo and providing cattle accommodation; but in a steamer intended for the carriage of timber, grain, coal and bulk cargoes, such a deck obstructs the handling of self-trimming cargoes. Yet, the habit of the old-time two-decker and three-decker was constant, until wide-spaced strong beams began to be fitted in place of a lower deck. Later, demands of timber traders caused the realization of the fact that these beams could be left out if the strength of the framing was increased. The possibility of interfering with the second deck in a three-decker was not contemplated fifteen years ago, and it is only ten years since the change to one deck was made in the steamer *Lincluden,* built by Furness, Withy & Company, Ltd., Hartlepool. Single deckers of 28 feet depth are now well known. A development has also taken place in the simplification of vessels in which the depth is so great that subdivision is necessary in order to render possible the carriage of general cargo in the holds. The Glasgow-built steamer *City of London** has a depth so great that, in very recent days, she would have been regarded as impossible with less than two or three 'tween decks and a tier of hold beams. Such vessels are now constructed with only one 'tween deck space, 11 feet in height, and no beams below the second deck.

Other new developments are Harroway & Dixon's "cantilever" ship, in which a triangular corner of the top sides is cut off for water ballast; McGlashan's "double-skin" ship; Isherwood's longitudinally stiffened hull, and Burrell's "straight-back" steamer. The latest is the steamer *Thor,* 7,500 tons dead weight, built last year by Ropner, of Stockton, and classed with the British Corporation. She is built on Ropner's trunk principle (a turret without the rounded base or the round-over at the junction of the harbor deck and side plating), but the trunk has two walls on each side, between which are 500 tons of water. The engines are aft; there are no bulkheads between the machinery space and the fore peak; there are two hatchways, each over 100 feet in length and 28 feet in width, and the top structure is supported by strong webs in the holds, to the practical exclusion of cross-ties and stanchions. The tendency of the classification societies is to broader views, though endeavoring to insure strength, efficiency and the highest quality of workmanship in the vessels constructed under their supervision. They are now more disposed to aid structural designs in better directions, realizing that many of their former rules were founded upon obsolete practice. The shipbuider has thus advanced during recent years in the simplification of hull structures, through reduction of the number of its parts.

Though 1907 was the year of the ocean liner and of the fishery steamer, there have been improvements in other directions which promise to have more effect on the working of the world's mercantile marine. The tramp is the mainstay of the shipping industry, and anything which makes this type of vessel more easily handled and faster, without increasing expenses, is a benefit to the whole community. In the clear holds the early turrets had not very much advantage over ordinary steamers, but the newer turrets and trunks and Sir Raylton Dixon & Company's "cantilever" vessels are designed to present no obstacles whatever to the handling of cargo, having neither pillars nor beams to break the expanse of hold space, and having continuous hatchways all over the holds, and derricks commanding every place where cargo is stowed. The masts have disappeared and their places taken by an array of derricks. The engines are usually aft, and the vessels are large, hollow steel girders, into which cargo can be loaded, and from which it can be discharged with the minimum of labor and time. The clear-hold, self-trimming and self-loading and discharging steamer is the cargo steamer of the future.

Then as to motive power, the British torpedo destroyers have proved the efficiency of oil fuel and turbine machinery working in combination, but oil-burning boilers must be restricted to war vessels or to vessels trading between ports where oil is obtainable. As to steam propelling engines, there have been several reports of inventions to supersede the turbine, but these have been nearly all of the nature of reversing turbines, and in no case has a detailed description been published. The reversing turbine will come some day, but meantime nothing has superseded the plan of having two turbines on the same shaft—one ahead and the other astern. The internal combustion engine may displace, not only oil fuel and boilers of all kinds, but also both types of steam engine, but we have not yet got internal combustion engines for propelling ordinary vessels. The difficulty seems to be in the unreliability of cast iron and cast steel to withstand serious and quick changes of temperature. The oil motor is the only new type which has been tried in practice, and in the course of this year it will be tested in a passenger vessel which MacBrayne & Company have had built for their West Highland service. She uses Scottish crude shale oil, and if the system is a success it will inaugurate a new development in marine engineering. An electric ship, with turbines to drive high-speed electrical generators, supplying current to motors to drive the propellers, is said to be in preparation. She, or something like her, will arrive some day.

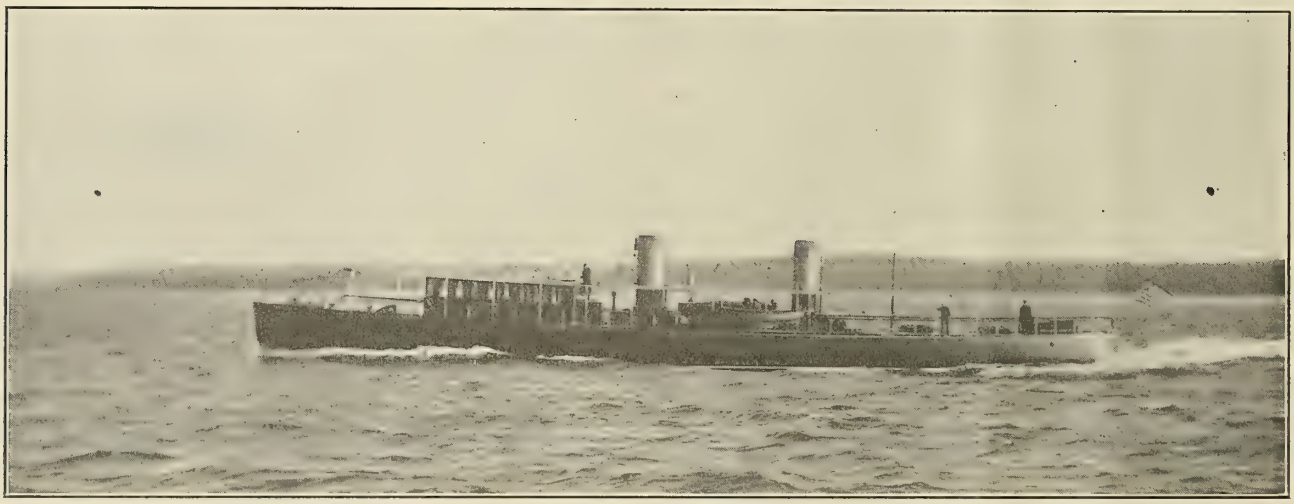
The Great Lakes Engineering Works, Detroit, Mich., launched, during the first week in February, two large freighters for service on the Great Lakes, the *Normania,* on Feb. 5, and the *M. A. Bradley,* on Feb. 8. The latter is 480 feet over all, 460 feet on the keel, with a beam of 52 feet and depth of 30 feet. Her deadweight carrying capacity will be about 8,300 tons. She is building for the Alva Steamship Company. The berth made vacant has been already taken by a new 10,000-ton steamer for bulk cargo service.

* International Marine Engineering, September, 1907, p. 345.

THE STEAM YACHT WINCHESTER.

This twin-screw yacht, built from the designs of Henry J. Gielow, New York, for Peter W. Rouss, of the New York Yacht Club, has a steel hull constructed by Robert Jacob, City Island, New York. The principal dimensions are: Length over all, 141 feet 6 inches; length on load waterline, 140 feet; width, extreme, 15 feet 6 inches; depth of hold amidships, 9 feet 9 inches, and 6 feet draft. The scantling is unusually heavy, giving great strength.

She was built in the best possible manner, and of a high quality of mild steel, the chemical tests of which showed not more than 0.06 percent of phosphorus, and not more than 0.04 percent of sulphur, and the material is of the best composition in other respects. In plates of No. 5 B. W. G. and heavier, the tensile strength is not less than 55,000 pounds, nor more than 60,000 pounds per square inch; plates lighter than No. 5 B. W. G. have a tensile strength of not less than 50,000 pounds per square inch. All plate material was tested, and gave an elongation of more than 25 percent in 8 inches. Test pieces cut from plates were bent over flat on themselves without sign of fracture,—in fact all the materials were thoroughly tested, and passed through a rigid inspection before being used. Every precaution was taken to make the craft safe, staunch and seaworthy.



THE STEEL STEAM YACHT WINCHESTER, RUNNING AT HIGH SPEED IN LONG ISLAND SOUND.

The keel is of the flat plate type, with intercostal keelsons extending above the floors and connected with continuous angle-bars riveted back to back, the plates being stapled to the floors and keel plates with angle-bars. The frames are of angle-bars 2½ by 2 inches by 2.75 pounds per foot. They are placed square to the load waterline, and spaced 20 inches between centers, stiffened by deep floors with reverse bars, which extend up to the turn of the bilge. The foundation and floor system in the engine room is carefully worked out, and when running at full speed there is not the slightest evidence of motion or swaying of the engines,—so commonly noticeable in high-powered steam vessels. The plating is run in fair lines, and in and out strakes, all horizontal seams being lapped and vertical seams butted. The thickness of plating ranges from No. 4 to No. 7 B. W. G. There are five watertight bulkheads in the vessel, dividing her into six watertight compartments, so that she is practically non-sinkable.

The arrangement, briefly stated, is as follows: Forward is a mahogany deck house 22 feet in length, the forward end forming a dining saloon, with a seating capacity for fourteen persons; this has a buffet, with mirror and cabinet for silver. Abaft of the dining-room, on port side, is a butler's pantry, with refrigerator and ice-box, dresser, sink, lockers and racks and a dumb-waiter leading to the galley below. On the starboard side is the captain's stateroom, fitted with a berth, wardrobe, wash basin, desk and chart rack.

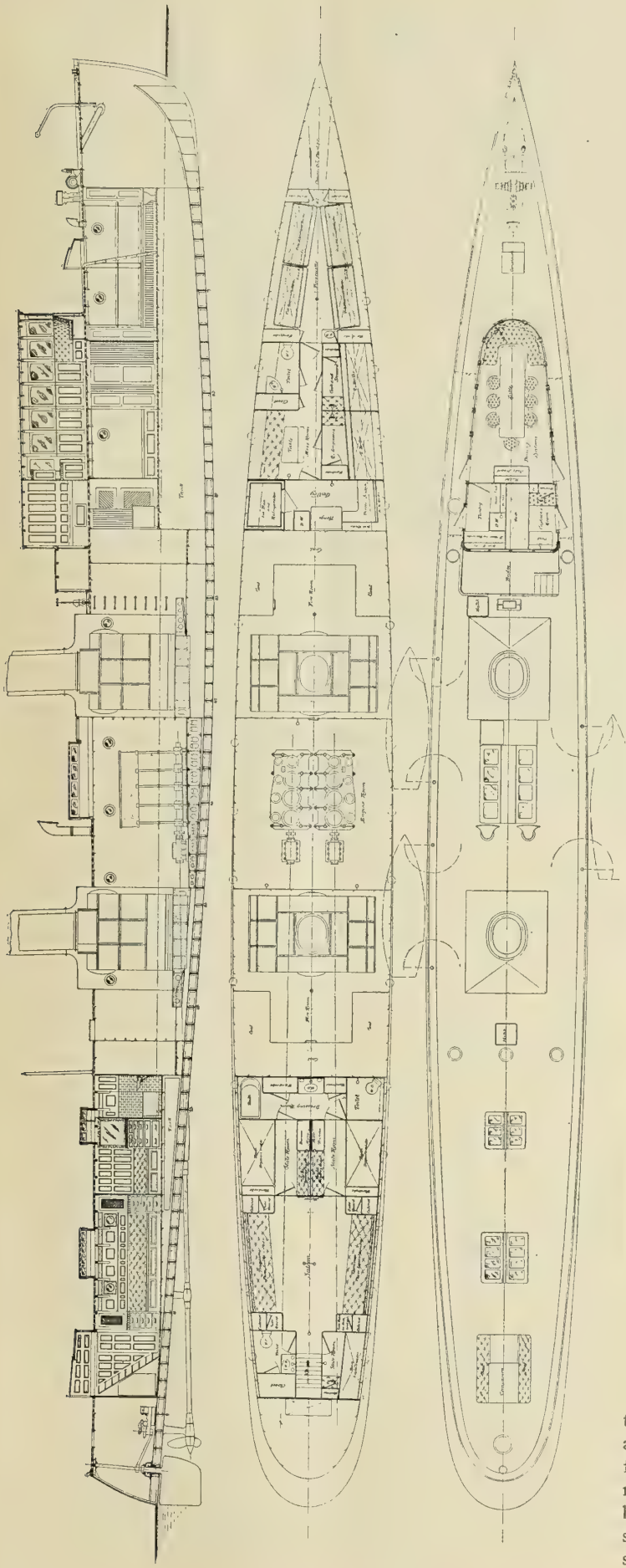
The quarters forward, below deck, for the crew are commodious and comfortably arranged, and the staterooms for officers are ample and pleasing. Then comes the galley, large, roomy and well ventilated, with a large ice-box and refrigerator fitted in addition to the usual dressers, shelves, lockers, dish racks, etc. The machinery space comes next, and in order to deaden the sounds, keep the heat away from the living quarters forward and aft, and reduce the labor of firing to a minimum, athwartship coal bunkers are fitted.

Abaft of the machinery space is a dressing room extending the full width of the vessel, with toilet and bath with tiled floor. Aft of this are two large connecting staterooms with wide berths, sofas, bureaus, etc., complete. Then comes a large cabin extending the full width of the vessel, arranged with sofas, sideboards, cabinets and bookcases. Still further aft on the port side is a toilet and bathroom, and on the starboard side is a stateroom. The sofas, berths, bureaus and sideboards are of selected mahogany, polished, and the rest of interior finish is in white enamel with line gilding.

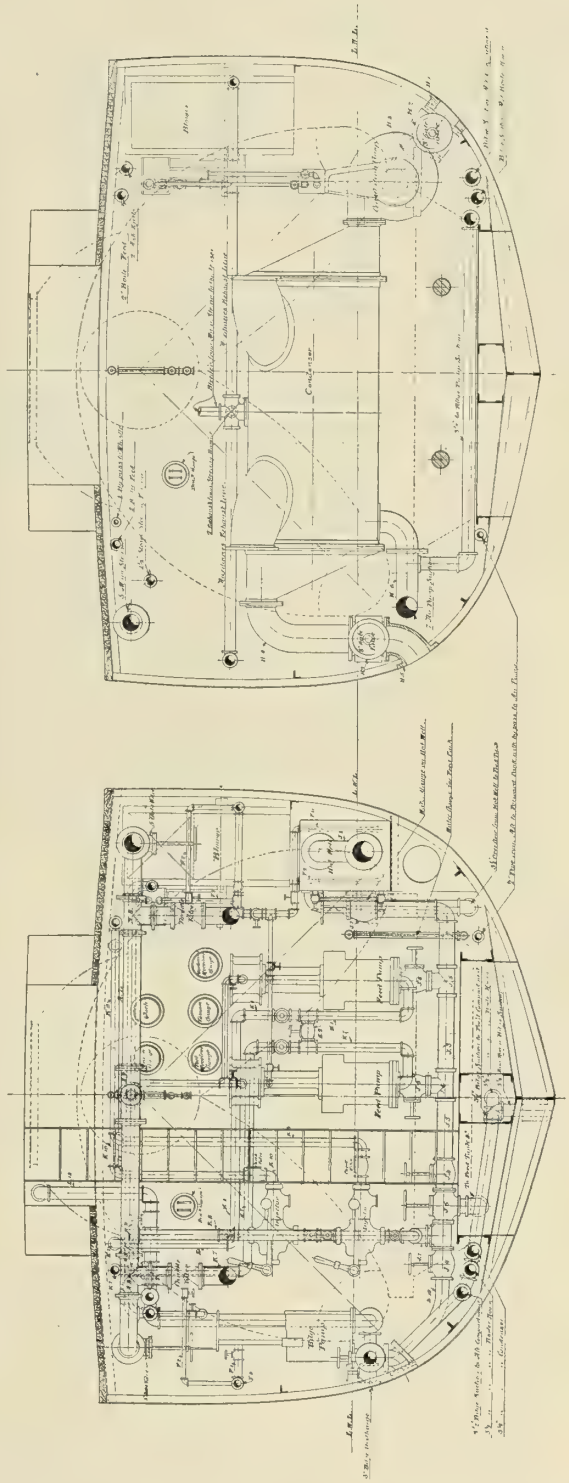
Particular attention has been given to the machinery, and nothing has been spared to have it first class, and to secure the smoothest running. The two main engines are of the triple expansion type, having four cylinders to secure perfect balance. The high-pressure cylinder of each engine is 12 inches, the intermediate 18 inches, and the two low-pressure cylinders each 20 inches in diameter; all with a common stroke of piston of 15 inches. Much care was given to balancing these engines, both in mechanical parts as well as valve adjustment, and the results have been exceedingly satisfactory, for when running at 350 revolutions or more there is practically no vibration.

Steam is supplied by two watertube boilers, built for a working pressure of 270 pounds to the square inch, with a combined grate area of 106 square feet and a heating surface of 4,600 square feet (ratio 43.4 to 1). Each boiler is placed in a separate compartment, with its own fire room, and is so arranged that the gage glass is in sight of the engineer, who controls the water supply, blowers, etc. Each fire room and the steam connections are so arranged that either one of the boilers may be used entirely independently of the other. The surface condenser was especially designed for this yacht, and there is no difficulty in maintaining a vacuum of 25 inches. The circulating pump is centrifugal. A complete set of pumps, injectors, bilge ejectors, etc., is supplied and installed.

No official trial trip was made, but during the engineer's trial

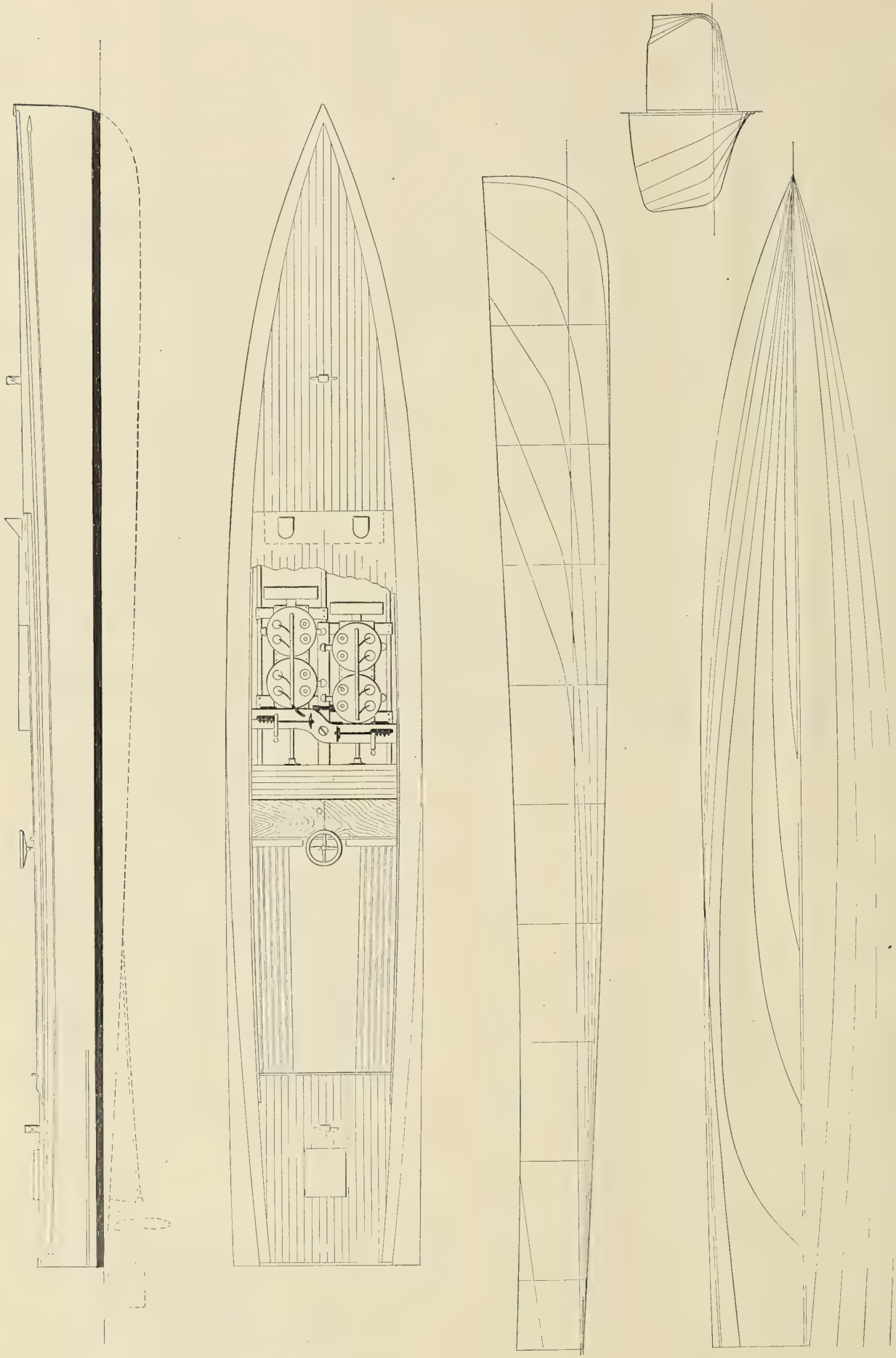


INBOARD PROFILE AND LOWER AND MAIN DECK PLANS OF THE 140-FOOT STEEL STEAM YACHT WINCHESTER, DESIGNED BY HENRY J. GIELOW.



TWO SECTIONS THROUGH THE ENGINE ROOM, SHOWING PIPING PLAN FOR THE PUMPS, CONDENSER AND OTHER AUXILIARIES.

the owner was aboard, and as everything worked perfectly, he accepted the boat upon that showing, without waiting for a formal trial trip. On this trial, a speed of 19.5 knots was maintained for 4½ hours. No maximum speed run was made, but several runs made subsequently, when in commission, showed the boat capable of maintaining a speed of over 25 statute miles per hour.

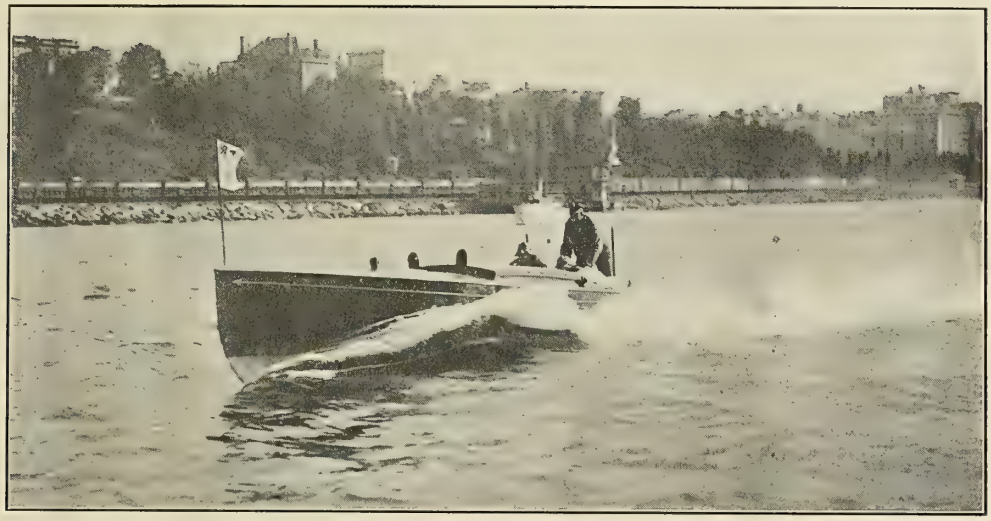


OUTBOARD PROFILE, DECK PLAN, LINES, BUTTOCKS AND BODY PLAN OF THE SPEED BOAT IRENE, BUILT BY JOHN S. SHEPPARD, ESSINGTON, PA.

High-Speed Motor Boats for Pleasure Use.*

BY HENRY R. SUTPHEN.

Several manufacturers are now prepared to deliver from stock, or upon short notice, 18 and 25-mile motor boats equipped with gasoline marine engines for pleasure use. About four years ago the high-speed gasoline launch was first introduced into America. The rates of speed then obtained were remarkable in comparison with the average launch of that day. The first boats produced were designed particularly for racing, and developed speeds of from 24 to 27 statute miles per hour, the hulls being of light construction and the engines of minimum weight. From the experience in building the racing launch, the high-speed pleasure boat has been developed, which fills the demand that has long existed for a safe, seaworthy boat that could cover distances over the water in the shortest possible time.



THE MOTOR BOAT IRENE RUNNING AT FULL SPEED ON THE HUDSON RIVER, BOUND NORTH.

On Sept. 28 the motor boat *Irene* was run six times over the government nautical mile course on the Hudson river, three with the tide and three against. The time for the various runs is given in the following table:

Down.....2.17 = 26.277	25.904	25.904	25.86	25.803	25.725
Up.....2.21 = 25.532	25.904	25.815	25.747	25.647	
Down.....2.17 = 26.277	25.726	25.678	25.548		
Up.....2.23 = 25.175	25.631	25.418			
Down.....2.18 = 26.087	25.205				
Up.....2.28 = 24.324					

25.725 nautical miles = 29.622 statute miles.

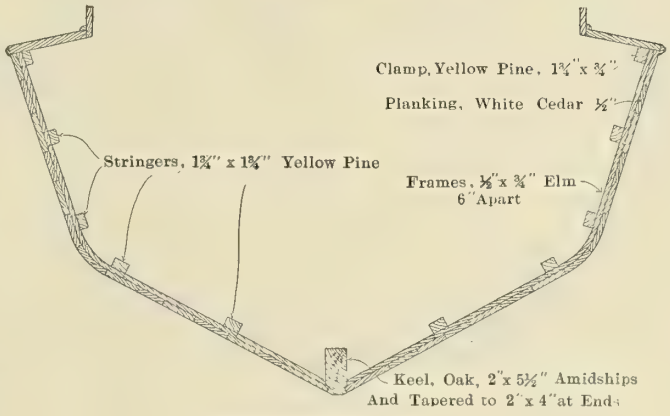
This is the highest speed that has been recorded in the trials held by the Motor Boat Club of America, which are yearly events, over the government course on the Hudson river. No special preparation had been made for the *Irene's* speed trials, the boat having on board during the trial 180 gallons of gasoline (petrol), five men and full equipment, the total weight being about 5,600 pounds.

The *Irene* was designed and built by John S. Sheppard, of Essington, Pa., who states that in racing trim the total displacement of the boat figures a little less than 25 pounds per horsepower. The two engines installed were built by the Chadwick Engineering Works, Philadelphia, and are each rated at 100 horsepower, each engine being of four cylinders, 8-inch bore by 7-inch stroke, turning 850 revolutions per minute. The propellers are of three-blade, 24-inch diameter, 44-inch pitch (pitch ratio 1.833).

* Read before the Society of Naval Architects and Marine Engineers, New York, Nov. 21, 1907.

A photograph is published of the *Irene* at full speed, with amidships section showing scantlings and planking employed. In comparison with a typical racing boat, the *Irene* could be classed more as a pleasure launch, the hull being of medium weight with wide beam and high freeboard. Total length of boat, 39 feet 8½ inches; beam, 6 feet 6 inches; draft at propeller wheel, 3 feet; freeboard amidships, 26½ inches. Large seating capacity is provided aft to accommodate eight to ten passengers, the general lines showing a fine entrance at the bow; amidships section as shown in plan; with a broad, flat stern, the latter materially assisting in holding the boat on an even keel when running at high speed.

The *Irene* is one of the first high-speed motor boats in this country to be equipped with twin screws, which give some advantage over the single screw for high-speed service. The side thrust of the single propeller is of considerable moment,


Clamp, Yellow Pine, 1¾" x ¾"
Planking, White Cedar ½"
Stringers, 1¾" x 1¾" Yellow Pine
Frames, ½" x ¾" Elm
6" Apart
Keel, Oak, 2" x 5½" Amidships
And Tapered to 2" x 4" at Ends

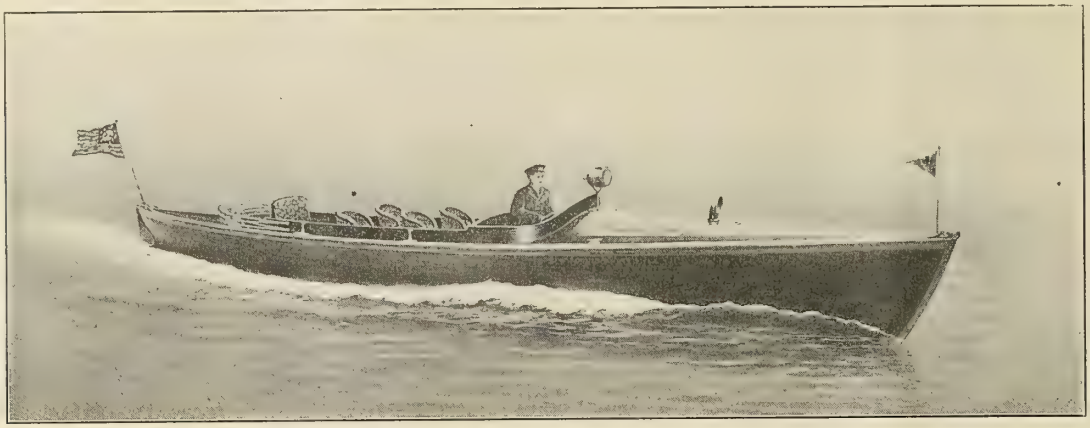
MIDSHIP SECTION OF THE IRENE.

and in some boats this is so great as to cause a decided list when running at high speed. With twin screws this is entirely obviated, and while the total weight of the power equipment is a little more, the steady operation of the boat in the seaway and while turning at full speed is of great advantage.

On account of the initial cost, cost of operation and maintenance, few desire for pleasure purposes a boat of 200 horsepower, and I therefore present photographs and drawings of high-speed motor boats of moderate power, which are the general type now built for pleasure use.

The 33-foot *Elco* express boat,* 5 feet 6-inch beam, is of light but substantial construction, equipped with a 4-cylinder, 40-horsepower gasoline engine of the auto-marine type, and

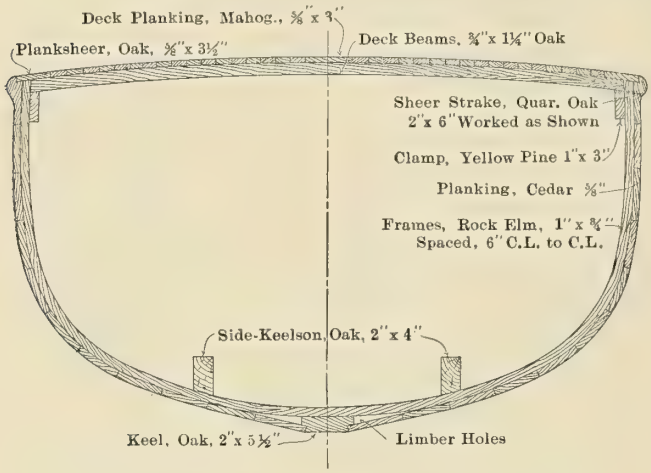
* Electric Launch Company, Bayonne, N. J.



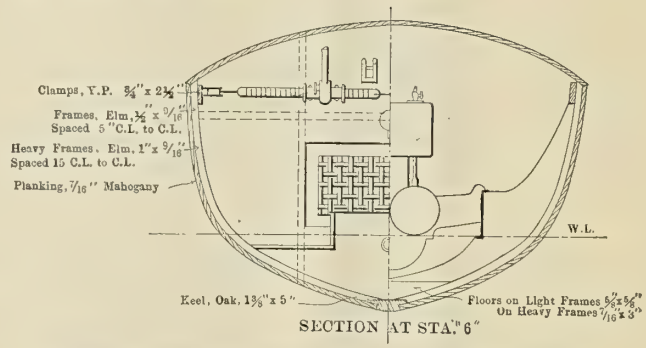
THIRTY-THREE-FOOT ELCO EXPRESS OPEN MOTOR BOAT ORIOLE.

develops a maximum speed of 20.4 statute miles an hour, as much as is required by the average owner. A section illustrates the scantlings employed in hull construction, the elevation and plan showing the general arrangement of power equipment and seating space. The weight of hull is 1,050 pounds, being in proportion to weight of power equipment (1,010 pounds); seating capacity, eight to ten passengers. This type of boat has proved very seaworthy, reliable in operation, and easily controlled.

Illustrations are also given of a 40-foot *Elco* express boat, 5 feet 6-inch beam, details of construction being shown in the amidships section. This boat is equipped with a 4-cylinder, 70-horsepower engine and develops a speed of 24.4 statute miles per hour. The general arrangement is similar to the 33-foot boat, and is the plan usually employed in this type of launch. The engine is located forward under removable hood,


Deck Planking, Mahog., ⅝" x 3"
Planksheer, Oak, ⅝" x 3½"
Deck Beams, ¾" x 1¼" Oak
Sheer Strake, Quar. Oak 2" x 6" Worked as Shown
Clamp, Yellow Pine 1" x 3"
Planking, Cedar ⅝"
Frames, Rock Elm, 1" x ¾" Spaced, 6" C.L. to C.L.
Side-Keelson, Oak, 2" x 4"
Keel, Oak, 2" x 5½"
Limber Holes

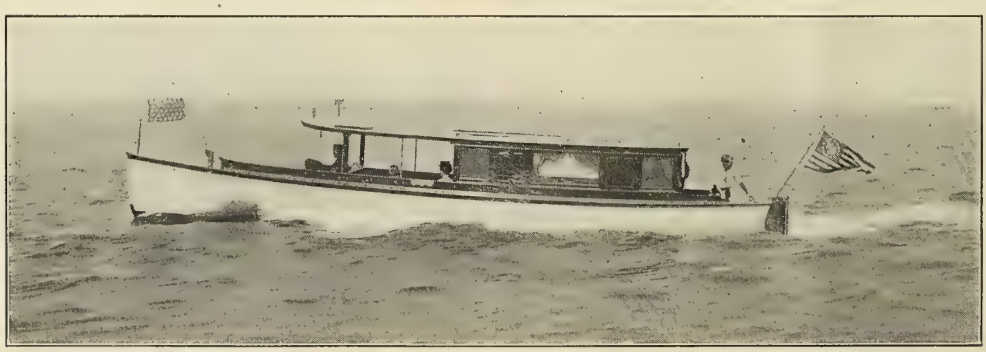
MIDSHIP SECTION OF 40-FOOT ELCO EXPRESS BOAT.


Clamps, Y.P. ⅝" x 2¼"
Frames, Elm, ½" x 5/16" Spaced 5" C.L. to C.L.
Heavy Frames, Elm, 1" x 3/16" Spaced 15 C.L. to C.L.
Planking, 7/16" Mahogany
W.L.
Keel, Oak, 1⅜" x 5"
Floors on Light Frames ⅝" x ⅝"
On Heavy Frames 7/16" x 3"
SECTION AT STA. "6"

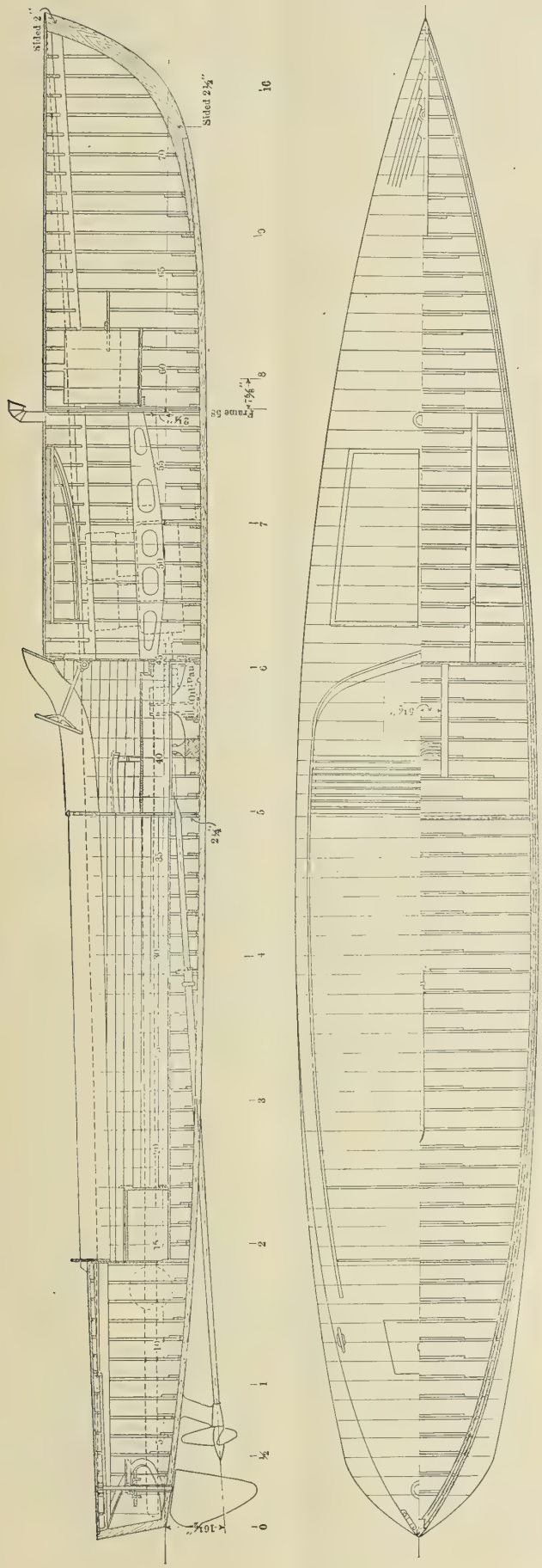
MIDSHIP SECTION OF 10-METER ELCO EXPRESS BOAT ORIOLE.

separated from the operator and passengers, the controlling levers being placed on the bulkhead aft of the engine, at which point the steering wheel is located, enabling one man to operate the boat, who oftentimes is the owner. To give the passengers protection from flying waters, headwinds and rain, a glass wind shield and folding hood are provided. This type of boat, it is claimed, will serve one on the water as the automobile does on land.

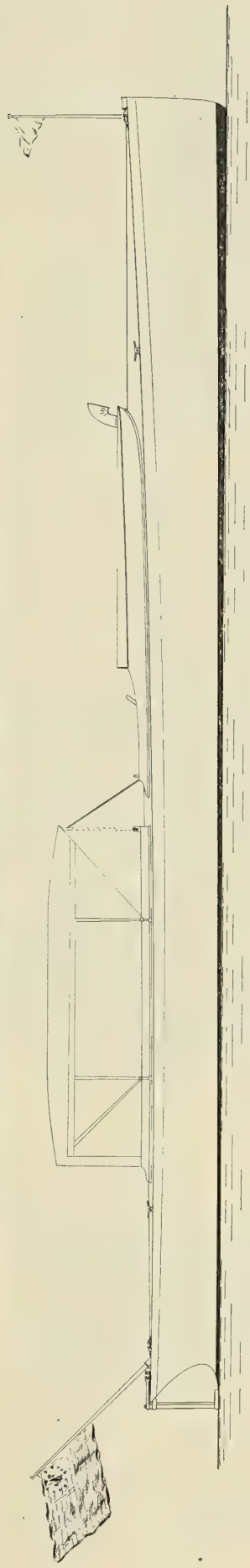
While the principal development of the high-speed launch has been in the open type of boat, attention has lately been given to the cabin launch, affording still further protection, comforts and carrying capacity combined with high speed. A photograph of the *Carlotta* illustrates a 40-foot by 8-foot beam cabin launch of unique design. The motor is placed forward, protected with hinging hood, controlling levers and steering wheel located in engine cockpit. The boat is handled and the engine controlled by one man; an open space covered by the cabin roof adjoins the engine compartment, separated by a glass wind shield; with commodious cabin amidships inclosed by plate glass windows, and with buffet and toilet compartments. The amidships section shows the scantlings and

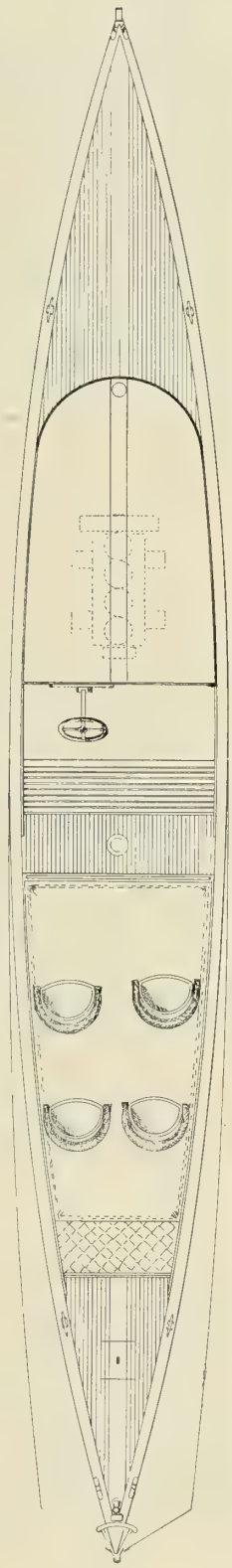


FORTY-FOOT ELCO EXPRESS CABIN MOTOR BOAT CARLOTTA.



INBOARD PROFILE AND CONSTRUCTION PLAN OF THE 10-METER (33-FOOT) ELCO EXPRESS BOAT ORIOLE, BUILT BY THE ELECTRIC LAUNCH COMPANY.





THE ELCO EXPRESS BOAT CHAPALA, 40 FEET LONG, 5 FEET 6 INCHES BROAD AND 2 FEET 4 INCHES DRAFT, BUILT BY THE ELECTRIC LAUNCH COMPANY.

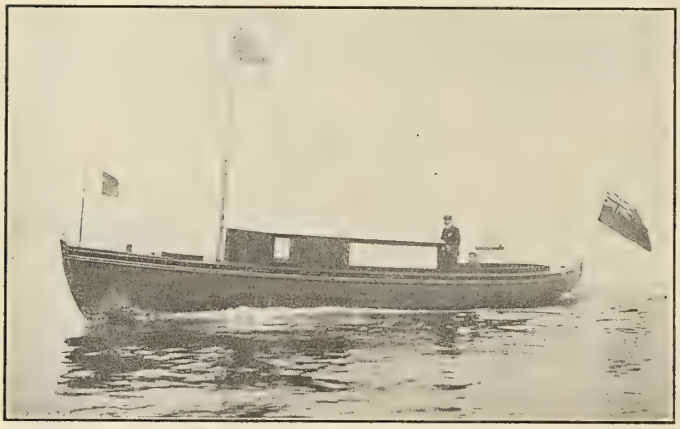
details of construction, which are light, but found to be substantial. The boat is equipped with a 6-cylinder, 75-horsepower engine, with which power a speed of 18.85 statute miles an hour has been obtained. The photograph was taken when the boat was running at full speed.

The possibilities of further development of the high-speed motor boat for pleasure use are limited only in details of hull and engine construction, the aim being to design and build boats that best conform to the high-speed gasoline marine engine, which has made possible this new type of power boat.

Clyde-Built Motor Launches.

We present photographs of two motor launches recently designed by Mr. C. L. Ewen, naval architect, Glasgow.

The *Brandane* was designed and constructed for the Marquess of Bute. The length is 42 feet, beam 8 feet, draft aft 3 feet. She is an able sea-going launch, and is used principally by Lord Bute for fishing and trawling purposes. The



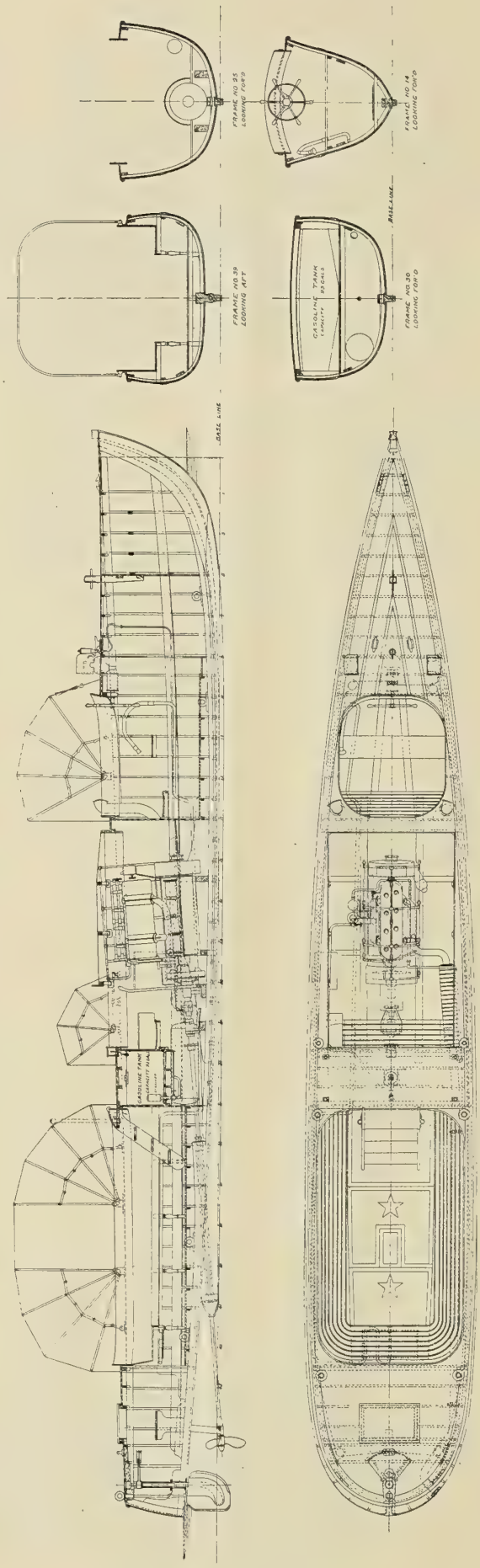
THE MOTOR LAUNCH BRANDANE.

engine is a 22 brake horsepower Mitcham "F. & B." triple-cylinder two-stroke cycle petrol (gasoline) motor, which turns up a 32-inch three-bladed propeller at 500 revolutions per minute. The consumption of petrol is small, averaging only 2 gallons per hour. The speed is about 10 knots.

The *Border Chief* was designed and constructed for Spowart Brothers. Her length is 40 feet, beam 10 feet, draft 2 feet 6 inches aft. She is a ferryboat with a Board of Trade certificate for fifty-four passengers, and is used on the River

THE MOTOR FERRY BOAT BORDER CHIEF, WITH HEAVY LOAD.

Tweed between Berwick and Spittal. In four months she carried 60,000 passengers, and is giving great satisfaction. The power in an 11 brake horsepower Mitcham "F. & B." double-cylinder two-stroke cycle petrol motor, which gives a speed of about 7 knots.



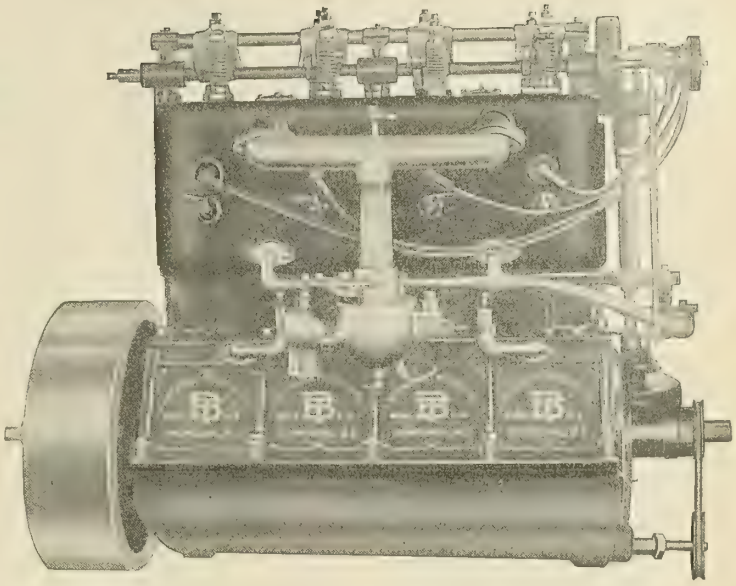
INBOARD PROFILE, PLAN AND TRANSVERSE SECTIONS OF MOTOR-PROPELLED ADMIRAL'S BARGE ATTACHED TO THE FLAGSHIP CONNECTICUT OF THE AMERICAN PACIFIC FLEET.

A Rear Admiral's Motor Barge.

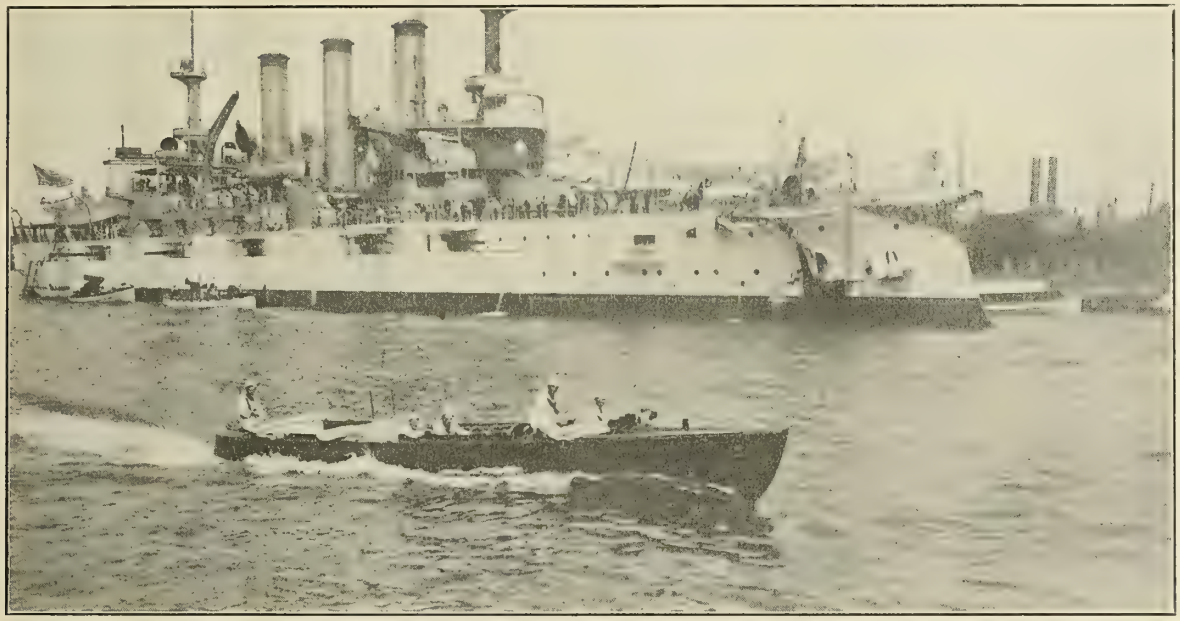
The photograph and drawings illustrate a 40-foot gasoline (petrol) barge, built at the Norfolk navy yard for the use of the commander-in-chief of the North Atlantic fleet of the United States navy. This barge, as tender to the flagship *Connecticut,* is now on its way to the Pacific in connection with the cruise of the squadron of battleships.

The boat is 40 feet in length over all, 38 feet 6 inches in length on the waterline, 5 feet 9 inches maximum beam on the waterline, and it has a maximum draft of hull forward of 17 inches. The displacement in normal running condition, with five men on board, is about 6,500 pounds. The motor is a Brownell-Trebert four-cylinder, four-cycle, and is rated at 75-brake horsepower at about 850 revolutions per minute. The highest revolutions obtained on trial were 771, which gave a corrected speed of 19.28 statute miles per hour. The propeller was not, however, a very efficient one, the apparent slip, which in a boat of this type should not be very different from the real slip, being only 14.8 percent with a pitch ratio of 1.1.

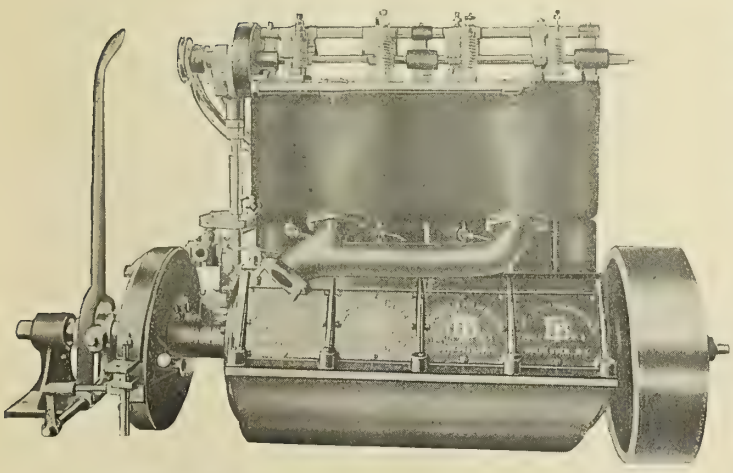
The lines of this boat are very fine, and the bow was made of a shape to overcome the trouble from flying spray. The result is a very dry boat, but the form does not produce quite as good a sea boat as if there were considerably more buoyancy below water forward. The boat is of the dolphin model, and is said to ship no water, even in a considerable sea. The model is such that she cuts the water like a wedge, and with an almost total absence of spray going on board.



THE FOUR-CYLINDER 80-HORSEPOWER MOTOR, INTAKE SIDE.



THE MOTOR-PROPELLED BARGE OF REAR ADMIRAL EVANS. BATTLESHIP CONNECTICUT IN BACKGROUND.



THE FOUR-CYLINDER 80-HORSEPOWER MOTOR, EXHAUST SIDE.

The engine, which was built by the F. A. Brownell Motor Company, Rochester, N. Y., has four cylinders, 6¾ inches in diameter with a 6-inch stroke. There are but two in-take and two exhaust pipes for the four cylinders, the latter pipes being carried downward to the lower part of the cylinders, where connection is made with the manifold. The engine weighs complete 1,500 pounds, and drives a propeller 24 inches in diameter and 26½ inches in pitch, through a propeller shaft of 1¾ inches. The extreme length of the engine, from the end of front bearing to the outside face of fly-wheel, is 48 inches; the length over cylinders is 34 inches; the height from center of crank shaft to clear everything on top of the motor is 31 inches; the width over the base is 20 inches; the width between keelsons is 22 inches; the distance from the front

face of fly-wheel to the center of the knuckle joint on the reverse gear is 16 inches; the diameter of the fly-wheel is 20 inches.

Just aft of the engine room is an athwartship fuel tank, with a capacity for 93 gallons of gasoline, and fitted with a strainer in the pipe supplying fuel to the engine. Counterbalance slings are attached for hoisting, with hooks aft, amidships and forward, and also side hooks amidships. There are four canopies for protection in wet weather, two being over the cockpit aft, one over the steering position forward, and the fourth, which is a small one, is over the rear end of the engine, and protects the engineer. There is a speaking tube from the stern sheets to the steering cockpit, for the transmission of orders. The crew consists of five men—coxswain, seaman, engineer, machinist and ordinary seaman.

The barge is divided into five compartments by four athwartship bulkheads, located respectively on frames 5, 17, 31 and 44. The first is the collision bulkhead; the compartment aft of this contains the steering cockpit and space for stores; the third compartment contains the engine and accessories as well as the fuel tank; the fourth compartment is the hooded cockpit, while the after compartment may be used for stores, and contains also the steering quadrant operating the balanced rudder. Near the end of this compartment the exhaust is discharged above the water on the starboard side, after having passed through a muffler (silencer) located in the after end of the engine compartment. The cockpit has a seat running around the two long sides and the after end, and is entered by means of a short stair from the forward end, giving upon the top of the gasoline tank, which is built over as a flush deck.

SOME OBSERVATIONS ON MOTOR-PROPELLED VESSELS AND NOTES ON THE BERMUDA RACE.*

BY WILLIAM B. STEARNS.

In presenting this paper my chief object is to promote discussion of a subject which does not seem to secure from most naval architects the consideration that its importance warrants. In spite of the great progress already made, the traditions of steam are still so strong with most of the profession that any suggestion looking toward the application of internal combustion motors to anything except small vessels is treated as fanciful. While I would not for a moment advocate attempting to turn out a motor-driven battleship or express steamer at present, it seems to me that the time has come when we cannot longer neglect such a possibility of developing a prime mover more economical of space, weight and fuel, as seems to be offered by the explosive motor.

Stationary motors, giving upward of 2,000 horsepower per cylinder, are in successful operation to-day, and in these machines the thermal efficiency is well in advance of results which are obtained with the best steam plants. If an assembly having six of these cylinders could be devised for marine use, we should have a unit of 12,000 horsepower, and four shafts would make 48,000 horsepower available for a single vessel.

If, by the process of evolution, the weight of such engines can be reduced to any such extent as has been the case in the smaller machines, we shall have a power plant beyond the wildest dreams of the steam engineer. Naturally, we cannot expect to attain such results in a month or a year, but it is putting a very low value on the human intelligence to suppose that the difficulties to be met with in modifying and adapting existing forms so as to make such a machine successful are insuperable. It has taken steam a century to reach the stage where its development seems to be approaching finality. Is it not absurd to suppose, as several members of the profession have seriously suggested in my presence within a short time, that the gas engine is not capable of much greater development than it now shows? I remember in 1895 making a trip in, perhaps, the first motor boat built on the Clyde. The engine was a 10 or 12-horsepower Daimler, and on a three days' trip from Gourock to Oban we had an almost endless succession of difficulties, in spite of the fact that one of the best engineers of the Daimler Company accompanied us. The machine in every detail was crude, heavy and ill-adapted to its purpose. Yet in the short space of twelve years we have seen the principles embodied in that clumsy contrivance work a revolution in the propulsion of small vessels. Comparing the progress of the gas engine in its early years with that of steam, we are surely warranted in the belief that ten years has not seen its possibilities worked out. On the doctrine of chances alone we are safe in such an assumption. Looked at from this point of view, the 12,000-horsepower unit does not seem like such a stretch of the imagination.

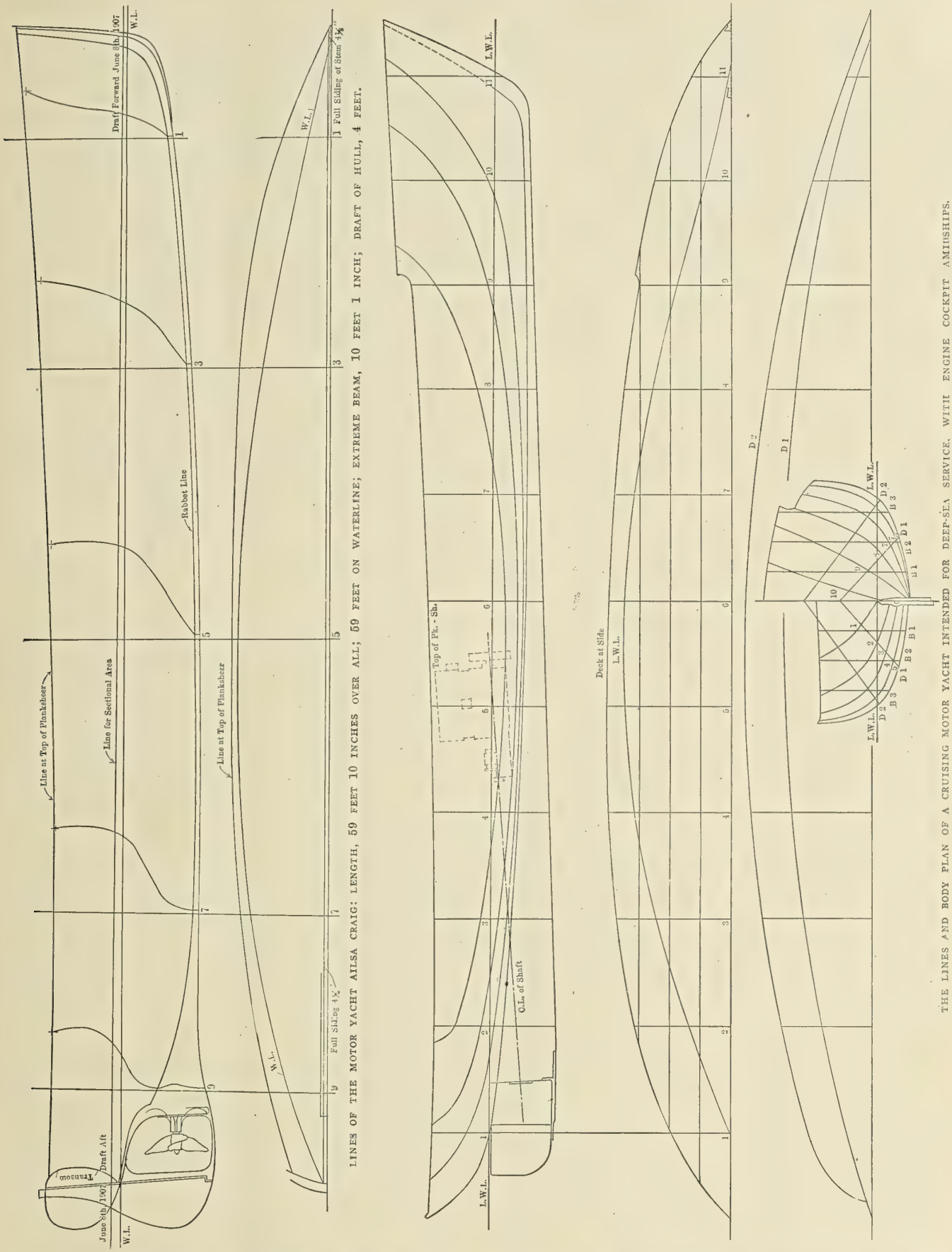
It is not within the scope of this paper to consider the motor itself from any point of view except that of the naval architect. I have recorded above, however, my views as to the importance of the subject, and it is with the idea that in such matters even small contributions are worth while that I venture to set forth here a few observations on certain aspects of the motor-propelled vessel as a whole. These observations have been made on comparatively small vessels, but I think the principles involved will apply equally well to larger ones, and it is from the lessons learned in small craft that we shall gain the experience necessary to make larger ones successful.

There are several details which occur to me wherein I believe the general treatment of the design of motor-propelled vessels must differ from that for steamers. The reason for this is that, except in vessels designed for weight carrying, or for craft of very high speed, the designer of the motor vessel is troubled to know how to get rid of the excessive buoyancy, quickness of motion, and general liveliness which result from the lightness of the propelling machinery and fuel. On a given length a fairly liberal beam is usually necessary to provide the accommodations required by most owners. Sufficient displacement is obtained with a very shoal body, and unless the weights are distributed in such a way as to offset it, there is a strong probability that the vessel will be very uncomfortable on account of quick rolling. This can be reduced, to a certain extent, by keeping down the area of the loadwater plane, and placing some of the weight fairly high. My experience in the Bermuda race, however, leads me to believe that valuable results may be obtained by further manipulation of the weights in a way which is usually fairly easy to accomplish. To make intelligible a comparison of their performances I will describe briefly the two boats which made the run.

The two boats were of utterly different type. *Ailsa Craig,* the winner, looks above the water like a handsome miniature ocean liner. She is narrow, high-sided, and with a very deep V section has a form of almost no initial stability. She is 60 feet long, approximately 10 feet wide, with a total displacement of something over 40,000 pounds. With her slack section, the depth from waterline to rabbet is very considerable. All her weights are carried low. Under the cabin floor are stowed about 8,000 pounds of lead ballast. Her fuel tanks, which, with their contents, weigh about as much more, are also stowed as near the bottom of the boat as they can be carried. The center of gravity of the engine is probably considerably below the waterline, and with the exception of a couple of boats carried on deck, and one stout mast, there was in the race practically no top weight. She is fitted with bilge keels, but I am uncertain as to their dimensions.

The other competitor, *Idaho,* of which I had the good fortune to be in command, is almost the antithesis of her rival. She is 56 feet on the waterline and 12 feet 9 inches in breadth.

* Read before the Society of Naval Architects and Marine Engineers, New York, Nov. 21, 1907.



LINES OF THE MOTOR YACHT AILSA CRAIG: LENGTH, 59 FEET 10 INCHES OVER ALL; 59 FEET ON WATERLINE; EXTREME BEAM, 10 FEET 1 INCH; DRAFT OF HULL, 4 FEET.

THE LINES AND BODY PLAN OF A CRUISING MOTOR YACHT INTENDED FOR DEEP-SEA SERVICE, WITH ENGINE COCKPIT AMIDSHIPS.

Her displacement in racing trim—that is to say, with 5,000 to 6,000 pounds of additional weight in the form of extra fuel, tanks, stores, etc.—is about 28,000 pounds. The depth from waterline to rabbet is 20 inches in normal trim, or only a little over one-third the corresponding depth of the other boat. The draft was limited to 3 feet 3 inches, and with a 25-horsepower Standard engine a speed was acquired of 11½ statute miles per hour. She was not, like *Ailsa Craig*, designed especially for

the race, but for a comfortable semi-cruiser. This resulted in a lightly constructed craft of excessive stability.

When the race was announced, and it was decided to enter the *Idaho,* it became a question of how to distribute the weight of extra fuel and stores to make her as little uncomfortable as possible in a seaway. The extra fuel, weighing with the tanks about 3,000 pounds, was finally placed in two long steel cylinders secured to the cockpit deck, as close to each side of the boat as we could get them. Nearly half the diameter of these tanks was above the gunwale. The rest of the cockpit space was then strongly decked over and made watertight with canvas. Between this temporary deck and the permanent deck of the cockpit we stowed reserve stores which, with the other supplies, made 2,000 to 3,000 pounds of weight at an average height of about 24 inches above the waterline. The center of gravity of the engine was roughly about on the waterline. The only low weight was that of the fresh water, weighing about 1,200 pounds, of which the center of gravity was some 10 inches below the waterline. In normal condition the metacentric height was about 5 feet. In trim for the race it was about 2 feet 6 inches.

No opportunity for a test was afforded until the second day of the race, when in the middle of the Gulf Stream a stiff northwest breeze began to raise a sea sufficient to cause a good deal of motion. All on board were most agreeably surprised at the result, but it was not until the return trip that we had a chance to compare *Idaho's* performance with that of *Ailsa Craig.* Coming home, the two boats made 350 miles of the run in company. In a very moderate seaway, *Ailsa Craig* rolled almost without intermission from 20 degrees to certainly not less than 40 degrees. On the *Idaho* I had fastened to the binnacle an improvised clinometer made of a semi-circularly bent tube containing colored alcohol and an air bubble. With a scale of degrees this enabled me to observe with fair accuracy the amplitude of her worst rolling. The heaviest roll observed was 23 degrees from the perpendicular, during a 35-knot quartering breeze. The sea at this time was quite heavy and very short. The period of rolling was not accurately observed, but the easiness of the *Idaho's* motions may be judged from the fact that when the sea was the roughest a quart milk bottle would almost but not quite stand on end without capsizing. After the passage of a series of steep waves, the boat would quiet down and for several minutes would run along very smoothly. It seems to me that this performance cannot be entirely accounted for by the amount of top weight carried, and I believe the dynamic effect of the two fuel tanks spread so far apart must have had an important part in making her so easy. I think this all goes to show that shoal-bodied boats can be made comfortable in a seaway, and I believe it is much more advisable to depend for the solution of the problem on the principles used on the *Idaho,* rather than to resort to the use of ballast, or bilge keels, which were certainly ineffective on the *Ailsa Craig.*

While on the subject of hull design, it may be interesting to speak of the surprising dryness and general seaworthy qualities of vessels of the type of the *Idaho.* Unfortunately, in the Bermuda race we had practically no opportunity to try the boats against a head sea. Both during the race and on the return trip all the strong breezes experienced came from abaft the beam, but on several other occasions I have been in craft of this sort in comparatively rough water, and have found them astonishingly good sea boats. If anything, the tendency is to recover too quickly after plunging into the sea. This is due, of course, to the extremely high proportion of reserve buoyancy to displacement, and results in one fault—a tendency to pound. On account of this, I do not think it is always an objection to put a certain amount of weight near the ends, on the same principle that I advocate spreading weights transversely. Also, I believe that the lines both forward and aft, but especially forward, of a light displacement motor-driven vessel, should be kept considerably finer than would be found necessary on a steamer of the same size. A comparatively minor matter, to cite another point of difference, is the rudder. I believe a motor vessel will generally require a larger rudder than a steamer. We found on the *Idaho* that it was difficult to meet her with sufficient quickness to avoid considerable deviation from the course when running before a sea, even with a rather large rudder area for her size. I think there are many other even more important points of difference which must be considered in the design of motor yachts, and, until we have acquired considerably more experience than at present, the commonly accepted ideas will have to be modified very frequently.

On most motor yachts, even of considerable size, owners usually desire that the engine room shall be in more or less direct communication with the rest of the vessel, although it would require only a small sacrifice of space to isolate it completely. I believe the advantages to be gained from making it a rule to do this in any yachts or other vessels of sufficient size would much more than counterbalance the sacrifice.

In a large motor yacht which is being designed by my firm for one of our clients at the time of preparing this paper, I have adopted some details of engine room arrangement which I have never seen used before on a motor yacht, but which I believe have many features to recommend them. The engine room is situated amidships, and at each end is a strong watertight bulkhead. The engine hatch is a section of the deck, so arranged that after the machinery is in place the hatch can be calked down and made tight. The tanks are situated in watertight compartments at each side of the engine room, and as the vessel is to be of wood, I propose to sheath the under side of the deck, the engine room side of the tank compartments, and the transverse bulkheads, with a thin sheet of asbestos and galvanized sheet iron. The companionway is conveniently situated, and so arranged that it can be readily closed. No other openings into the engine space are provided for, except an in-take and up-take for ventilation. An electric blower will be situated in the up-take, which will draw the air from under a grating in the engine room floor. The bottom of the boat will be cemented, so that in case of any leakage the flow will all be to a point under this grating and near the ventilator up-take.

All piping, wiring and shafts are to pass through the bulkheads in tight conduits or glands. Close to the under side of the deck I propose to place a contrivance made on the principle of the ordinary fire extinguisher; that is to say, there will be a tank containing a solution of bicarbonate of soda, and a flask of sulphuric acid will be arranged so that a blow on a plunger from on deck will break the flask, or spill the acid into the bicarbonate of soda solution. A pipe, or set of pipes, led from the bottom of the tank above the level of the liquid, will serve as the nozzle of the fire extinguisher. In case of fire, the engineer, after making his escape, could strike the plunger, close the hatch and ventilator openings, and the carbonic acid gas generated would quickly smother the flames. With an arrangement of this sort, it is difficult to conceive of a fire which would permanently disable the engines or seriously injure the vessel, and, as long as the blower was in operation, conditions could hardly arise which could lead to an explosion of any violence.

Only by using such precautions do I believe it safe to send to sea vessels containing large quantities of gasoline (petrol) for fuel, but in addition to the great feature of practically absolute safety this isolation of the engine room has many other advantages. The combustion of all hydrocarbon fuels results in the generation of a certain amount of carbon monoxide gas, which is a cumulative poison to the system and, when a sufficient quantity has been taken into the lungs, is the main

cause of the state which is popularly termed "gasified." No internal combustion engine of which I know is proof against a certain amount of leakage of these products of combustion past the pistons, and all of us who have had experience with ill-ventilated vessels have probably experienced the disagreeable effects of this gas, to a greater or less extent. Its complete elimination from the living quarters of a yacht or vessel ought to be an important consideration.

On the score not only of general comfort and livableness but of safety, I am strongly in favor of the use of electric lights on any motor craft of sufficient size to carry a serviceably large plant. On the *Idaho* we had a very perfect installation, and the comfort of always having plenty of light without the smell and other disagreeable features of kerosene can hardly be expressed. On the first night of the race we were unfortunate enough to clog a gasoline pipe, by which we lost an hour and a half of precious time and, incidentally, the race. As we were beaten by only thirty-five minutes, that hour and a half always weighed heavily on all those interested in the boat. At the same time, if we had not had electric lights with which to work, we could have done nothing towards freeing the clogged pipe until daylight. During the time we were working on the pipe, the engineer deliberately let several gallons of gasoline flow out into the boat and over the engine room floor. This may not have been a very prudent proceeding in any case, but it would have been an almost sure invitation to disaster had we tried it with any other system of lighting. The dynamo which drives this plant is secured to the forward cylinder head of the engine, and is driven by a belt. This belt is protected by a rigid iron guard, and neither dynamo nor belt is in the way in the slightest degree. Under the cockpit we had five cases of four cells each of storage batteries. These would run all the lights on the boat, about fifteen in number, for four hours, but as more than three or four lights at a time are very seldom required, there is really ample capacity for two or three nights' use of light without recharging. The switchboard is very ingeniously arranged with a rheostat controlling the voltage of the generator, and a five-point switch which throws in, one after the other, the cells in the last case of batteries, so that when the voltage begins to drop a little it can be maintained for a considerable time with the endalls before it becomes necessary to recharge. Voltmeter, ammeter and the required switches are arranged as usual. Tell-tale red and green lights, which cannot burn unless the side lights are lighted, are a very good feature, indicating at once in the engine room if a side light goes out. On deck we had a 9-inch searchlight of about 1,500 candle power. This will throw a brilliant beam into the sky, which is useful for signaling purposes, and on a dark night will light up objects at a distance of a good half-mile with sufficient clearness. Considering that the plant occupied very little space, required very little power and almost no attention, I think it was well worth while.

Turning from these details of general design and arrangement, I wish to say a few words with regard to engine and fuel problems. It does not require a prophet to foresee that in the very near future owners of motor yachts will rebel at the cost of gasoline. Even now its expense is prohibitive for commercial use in high powers, and the building of gasoline yachts has undoubtedly been restricted by its cost. As alternatives we have kerosene (paraffin) or producer gas, made either from coal or heavy oils. There seems to be no difficulty in the operation of certain types of motors by kerosene, but in some instances of which I have known there have been decided drawbacks to its use. At the same time the reduction in expense, although amounting to nearly 50 percent as compared with gasoline, does not bring the operating cost as low as that of a good steam plant for a moderate sized vessel. Of the use of crude oils and distillates we have not had much experience in this part of the country, but on the Pacific Coast vessels of 150 feet and over, which are driven by engines using crude oils, are not uncommon.

On the whole, the use of producer gas from coal seems to promise the best results both for yachts and commercial vessels, although when expense is not an object gasoline will continue to be used. This will undoubtedly be the case with a great many small launches, all speed launches, submarines, and vessels such as torpedo craft, which may be driven by motors in the future. For yachts the up-draft producer with hard coal will probably be employed, but the type to be used is at present a matter which concerns the engineer rather than the architect. There seems to be no reason why gas producers, substantially like those in operation on land, cannot be used successfully on ships, and in combination with an efficient motor they offer very great advantages over steam plants. With a good producer a thermal efficiency of 87 percent can be reached, and I understand that it is perfectly safe to count on 75 percent under ordinary service conditions of operation. The fuel consumption can be figured safely as half that of steam.

In connection with comparisons of fuel consumption, and incidentally with weights and efficiencies as between gas and steam engines, I have noticed that quite often the average figures of the gas engine are compared with rather ideal figures of the steam engine, to the detriment of the former. In present practice the average of the gas producer engine is about 1 pound of coal per horsepower-hour, but under good conditions, with a 350-horsepower engine, a rate of as low as ¾ pound per horsepower-hour has been obtained. Therefore, I do not think it is unfair to say that it is safe to figure the fuel consumption of a producer gas engine as half that of steam under similar operating conditions. In the same way we may safely assume that the weight of the complete gas power plant and the space occupied is from one-half to two-thirds that of steam. Of course these figures are only approximations, but I think there is no question that in units up to 500 horsepower they can be "made good" to-day. When we think of the reductions in weight which have been brought about in the last thirty years in steam engines and boilers, it is only fair to suppose that when gas engineers have a chance to introduce corresponding refinements they, too, will be able to make a vastly better showing.

There are undoubtedly many mechanical difficulties to be overcome; likewise it is only reasonable to suppose that with every step in advance new and unforeseen obstacles will arise, but with such a goal ahead as the gas engineer will have, I have perfect faith that he will be found equal to his task. While I am especially anxious not to appear as a partisan of the explosive motor, and recognize what marvels of mechanism are embodied in some modern steam engines, I believe that we are on the eve of a great revolution in marine propulsion. There is at least so much promise in this field that it is well worth the while of every naval architect in this country to afford what opportunity he can for exhausting all the possibilities, and if by any chance it turns out that we have been working on the right lines, and secure a lead over the rest of the world, we shall have taken a long step toward regaining for the country that position of importance on the high seas which all of us desire. At the present time much of the best work in developing low-cost fuels for the use of explosive motors is being done abroad, and if we do not show improvement in this respect England and Germany will soon be far ahead of us.

It is reported that the Chilean merchant marine is increasing very rapidly, and at present is exceeded by that of only one South American country—Brazil—which has a tonnage of 211,194 against 156,316 for Chile. Of the Chilean shipping, 107,727 tons are steam and 48,589 sail.

A GERMAN MOTOR CRUISER.*

BY PROF. WALTER MENTZ.

Up to date in Germany comparatively few seaworthy motor boats have been constructed which can make long cruises far from a base of supplies; for this reason the *Ouestphalia* will be of some interest. She has a length of 16 meters (52 feet 6 inches); a beam over the planking of 2.85 meters (9 feet 4½ inches); a depth of hull of 1.5 meters (4 feet 11 inches); a maximum draft of 0.8 meter (31½ inches), and a displacement of 8.2 metric tons (8.07 gross tons).

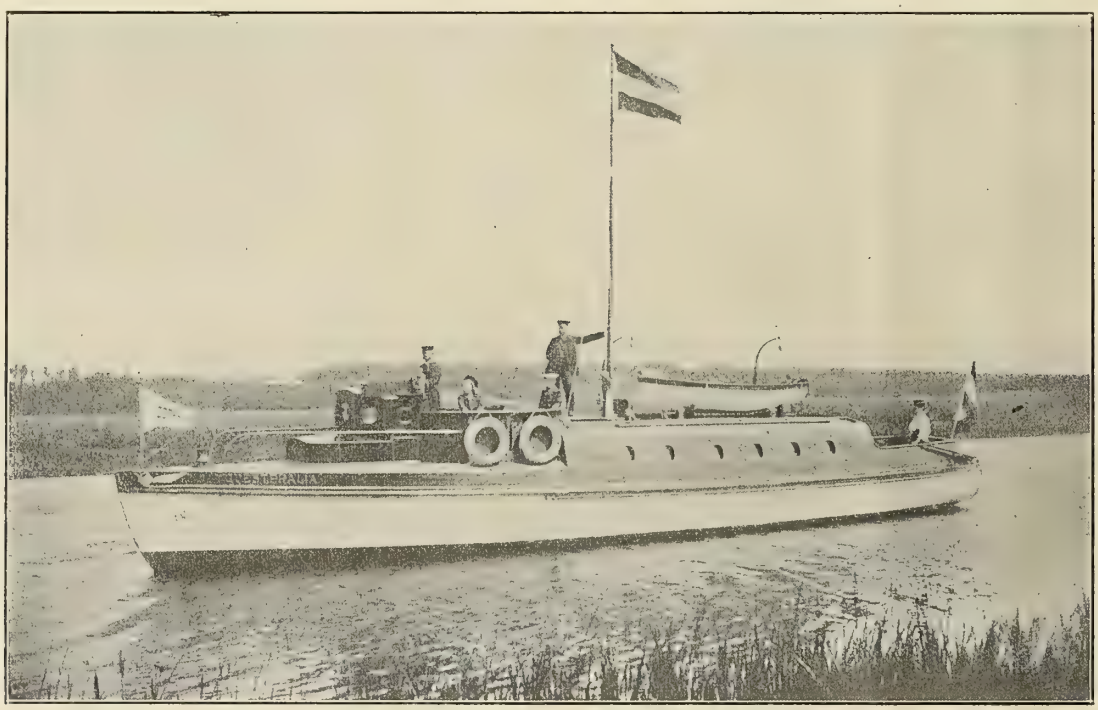
The length and draft of the boat were firmly fixed by a winding channel through which it was necessary to operate her between a small lake near the owner's home and open waters. In a similar manner the height of the vessel was circumscribed by reason of several low bridges under which she had to pass. In particular the davits had to be fitted so that they could be removed, and the mast was hinged. The raised steering position was similarly affected. The requirements called for two cabins, which could also be used as sleeping quarters for two persons each, and space for two members of the crew to sleep.

The construction of the vessel was by Fr. Luerssen, in Aumund-Vegesack, and the entire machinery equipment was superintended by the builder. The contract called for a speed, with a 23-horsepower motor, of 16 kilometers per hour (8 2/3 knots). In order to reach this speed, and also to enable the boat to be transported on the railroad, it was necessary to limit the beam to the figure above given.

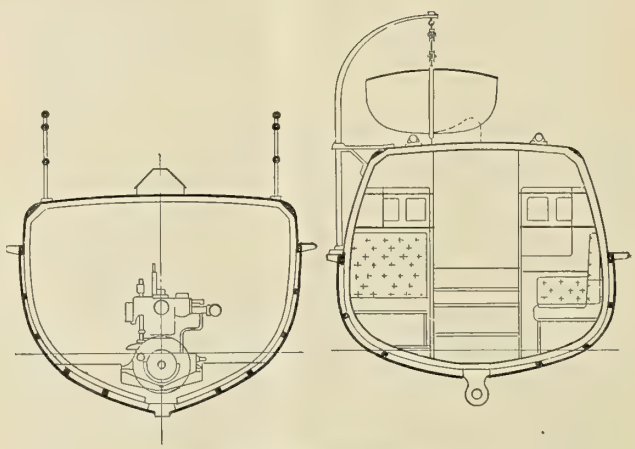
The hull is of novel construction, using steel frames with continuous longitudinal members and double planking with diagonal seams. As all the frames are carried up to the upper deck, and are here bound together by wooden deck beams, great transverse strength and elasticity of the hull are provided, particularly against such forces as come from stress of weather.

The frames, 31½ inches apart, are angles 1⅜ by 1⅜ by 5/32 inches, with beams of the same size carried across under the flooring. The pitch pine longitudinals, 2 by 2 inches, are outside the frames, and the inner course of planking (½-inch oak) is laid diagonally. The outer course is also of oak, 19/32 inch thick. The deck beams are spaced 15¾ inches, and consist of oak beams 1⅜ by 1 3/16 inches, with an iron bar 1⅜ by 5/16 inches alongside. The engine frame is carried on two longtudinal channels 4¾ by 2⅜ by 9/32 inches. The keel, 7⅛ by 4 inches, and the sternpost, as well as the longitudinal along the upper corner of the cabin, are of oak. The stem, gunwales and deckhouse are of mahogany. The deck is of Oregon pine; the flooring of larch. In the engine room the flooring is covered with 3/16 inch of lead.

The accommodation plan shows forward a chain locker with a small capstan above it. Then comes a crew space with lockers; next is the engine room, which contains the cylindrical gasoline (petrol) tank running athwartships at the forward end, and the engine and reversing gear. The galley and toilet occupy the next compartment, aft of which are the two cabins, each fitted with folding tables. This comprises all of the portion of the vessel covered by a deck. The after end is an open cockpit, with a canopy over it. The control station is located just above the intersection between the crew space

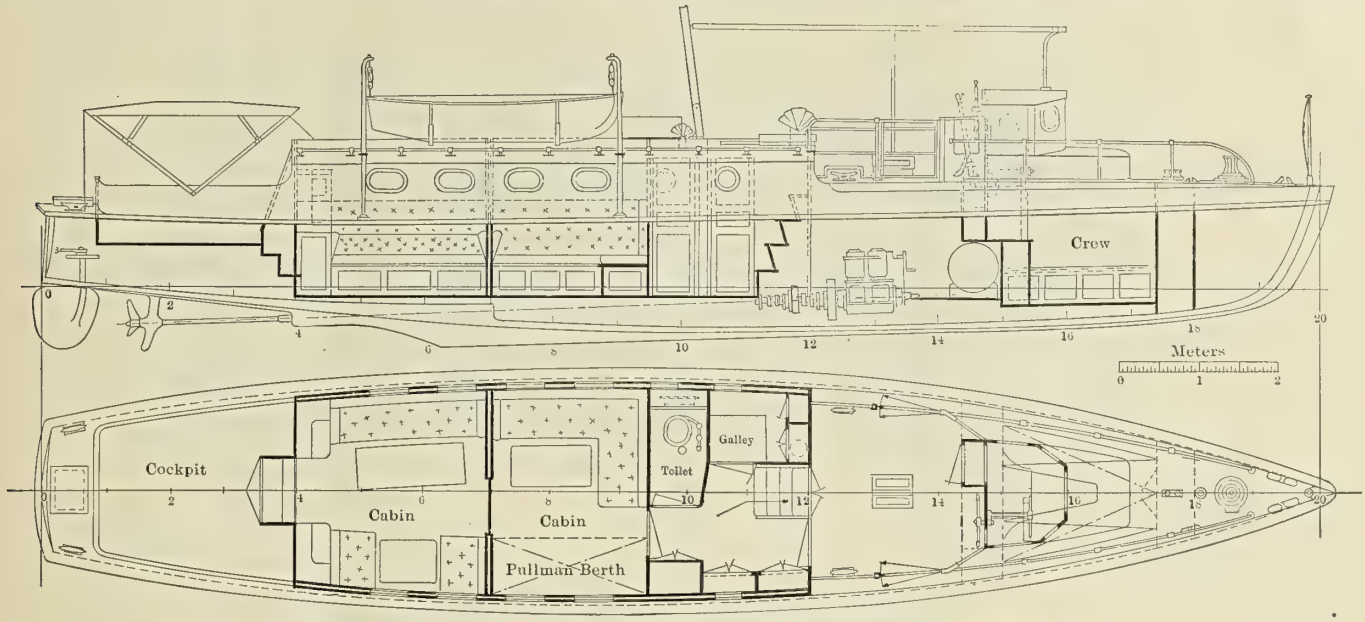


THE GERMAN CRUISING MOTOR BOAT OUESTPHALIA.



FRAME 13.—SECTIONS.—FRAME 4.

* *Schiffbau.*



GENERAL ARRANGEMENT, PLAN AND INBOARD PROFILE OF THE MOTOR CRUISER OUESTPHALIA.

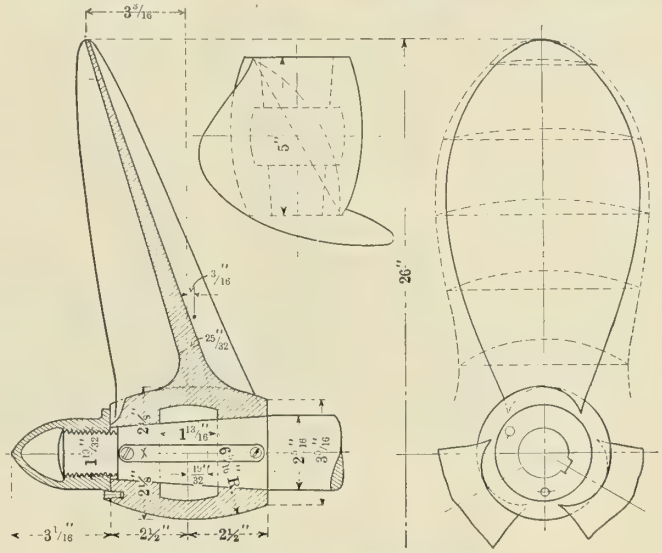
and the engine room, while a boat carried on davits from the starboard side is placed above the two cabins.

The engine is a two-cylinder Gardner motor with cylinders 7 inches in diameter and 6-inch stroke. The fuel contains an admixture of 20 percent of benzol. For reversing, the Hele-Shaw gear is fitted. The engine operates at about 600 revolutions per minute. Its weight, including the fly-wheel, is 710 kilograms (1,565 pounds). The reversing gear weighs 250 kilograms (551 pounds). The fuel tank holds enough fuel for a 26-hour run at full power. The air pressure tanks for signaling are placed in the engine room, the pressure being maintained by a small pump, which can be operated by a friction drive from the fly-wheel.

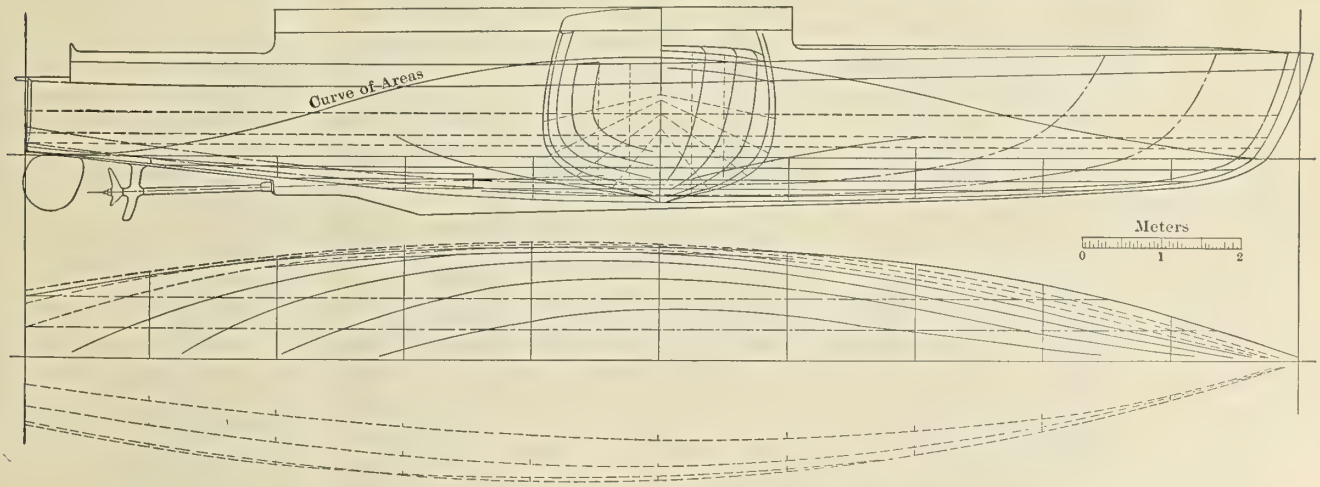
The deck over the accommodations is sheathed on the underside with wood ⅜ inch thick. The deck plank itself is 1 inch thick. The floors are covered with linoleum, and the trimmings are in mahogany. In the forward cabin the sofas are upholstered in moquette, while the after cabin is upholstered in neat's leather. All the sofas are arranged for occasional use for sleeping.

Ventilation of the crew space, the engine room, the galley and the toilet room is accomplished by ventilators fitted with small exhausters. The tender is made of cedar and fitted with sails. It has a length of 3.2 meters (10 feet 6 inches); and is easily handled by the davits.

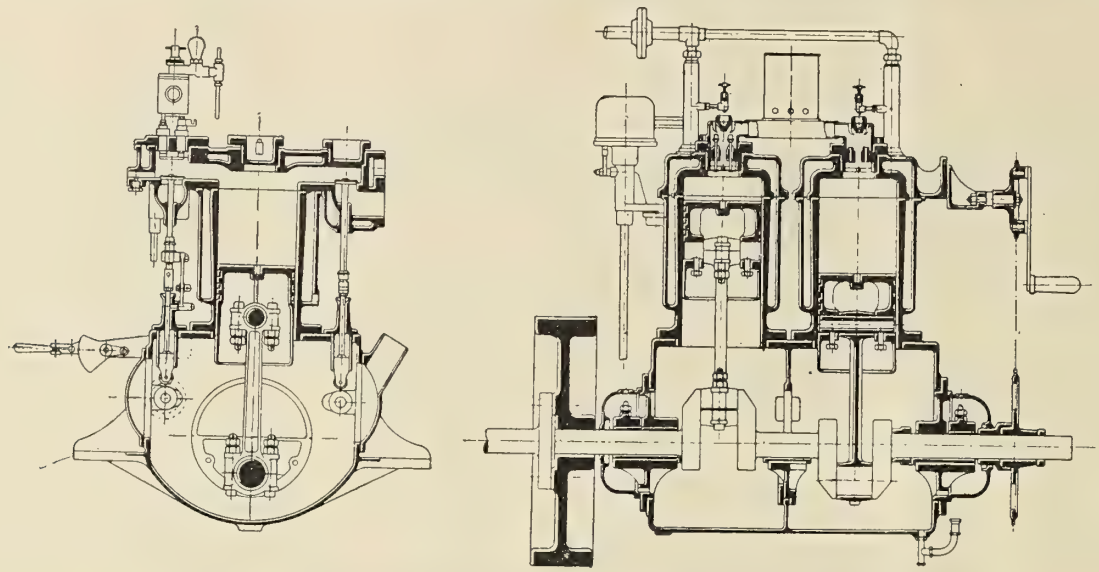
The propeller is solid, three-bladed, made of Niemeyer



PROPELLER DETAILS ON THE OUESTPHALIA.



LINES AND BODY PLAN OF THE GERMAN CRUISING MOTOR YACHT OUESTPHALIA.

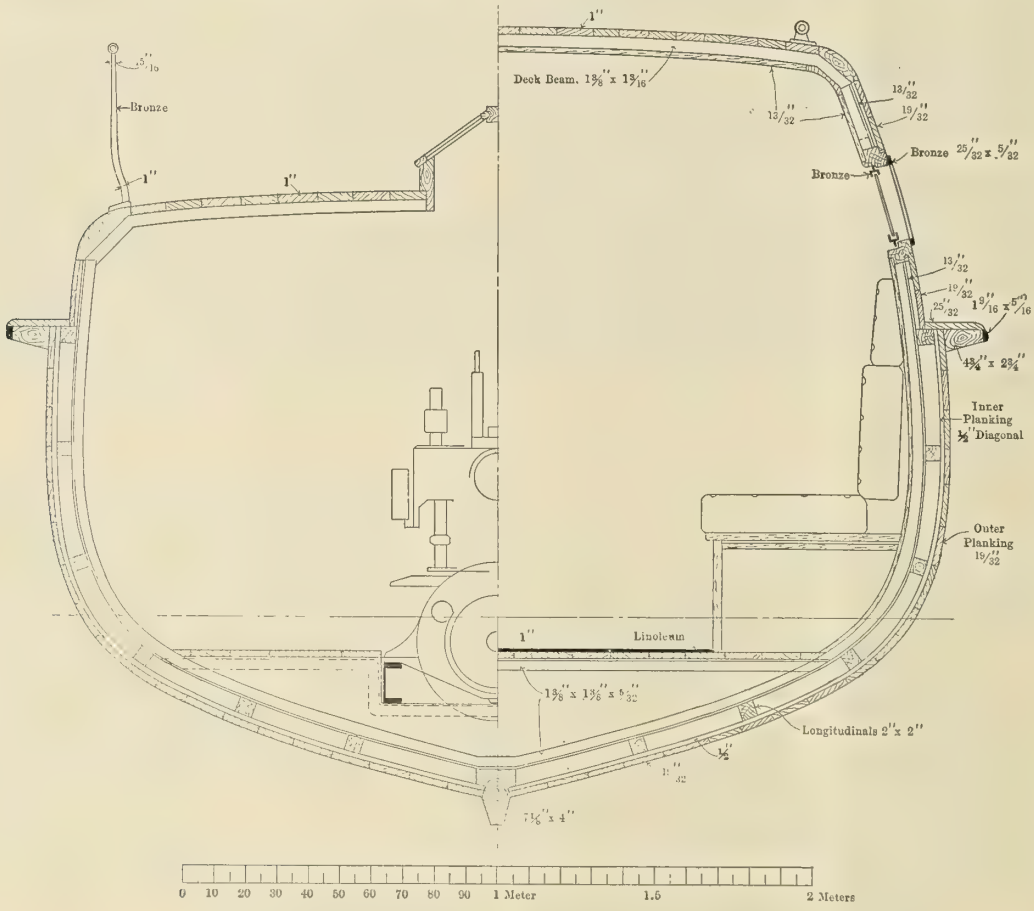


TRANSVERSE AND LONGITUDINAL SECTIONS OF TWO-CYLINDER ENGINE OF OUESTPHALIA.

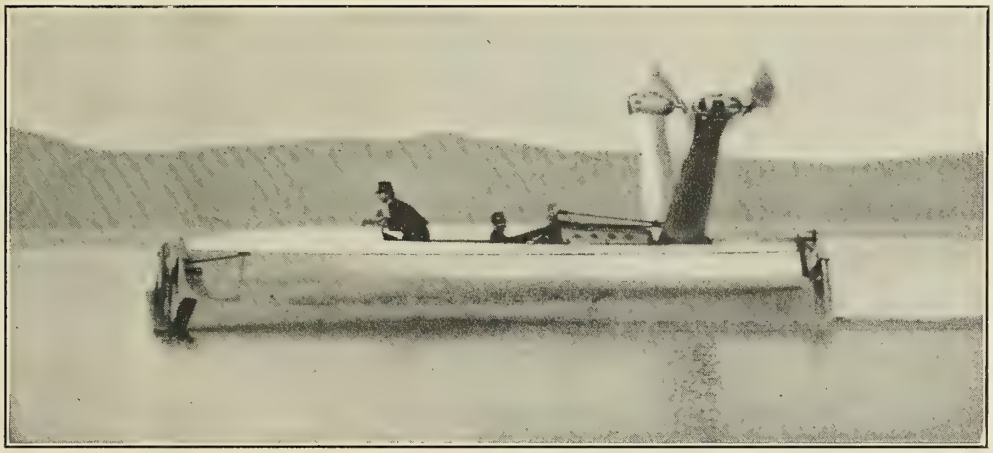
propeller bronze. It has a diameter of 660 millimeters (26 inches) and a pitch of 580 millimeters (22¾ inches); the pitch ratio is 0.88. The projected area of blades is 1,026 square centimeters (159 square inches); this gives 0.3 as the ratio between the projected area and the disk area.

On trial a speed of 16.1 kilometers per hour (8.68 knots) was obtained with 570 revolutions per minute, and a slip of about 19 percent. This trial was run in water with a depth of from 5 to 6 meters (16 to 20 feet), and against the current. The maneuvering qualities of the boat proved very good. In particular it was noticed that the wave thrown up was slight. The stability in a heavy seaway is said to leave little to be desired. The metacentric height is given as 73 centimeters (28.7 inches).

The Craig Shipbuilding Company is progressing rapidly in the construction of a complete shipbuilding plant at Long Beach, Cal., just south of Los Angeles. The buildings under construction include a structural iron shop, machine shop, mold loft, power house and foundry.



MIDSHIP SCANTLING SECTION OF THE CRUISING YACHT OUESTPHALIA.



THE CROCCO-RICALDONI HYDROPLANE AT FULL SPEED ON TRIAL TRIP: HULL 18 INCHES OUT OF WATER.

The Crocco-Ricaldoni Hydroplane Boat.

BY J. B. VAN BRUSSEL.

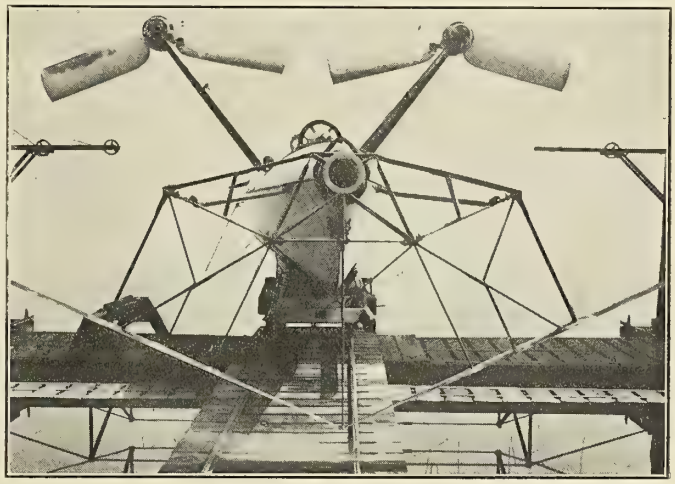
Two Italian officers, Lieutenant Crocco and Captain Ricaldoni, are experimenting with a new hydroplane motor boat of their designs, which presents some original features. The length is 8 meters (26 feet 3 inches), and she is fitted with a Clément-Bayard 80 to 100-horsepower motor, having cylinders 180 by 180 millimeters (7.09 by 7.09 inches), and working at a speed of 1,200 revolutions per minute.

It will be seen from the illustrations that the boat is provided with hydroplanes only at its stem and stern. The planes at the bow are arranged in the manner of a "V," while those aft, though similarly disposed, do not join at the inverted apex. These planes, and the principal members of the frames supporting them, are made of steel plating, the remaining parts of the carrier frame being of aluminum.

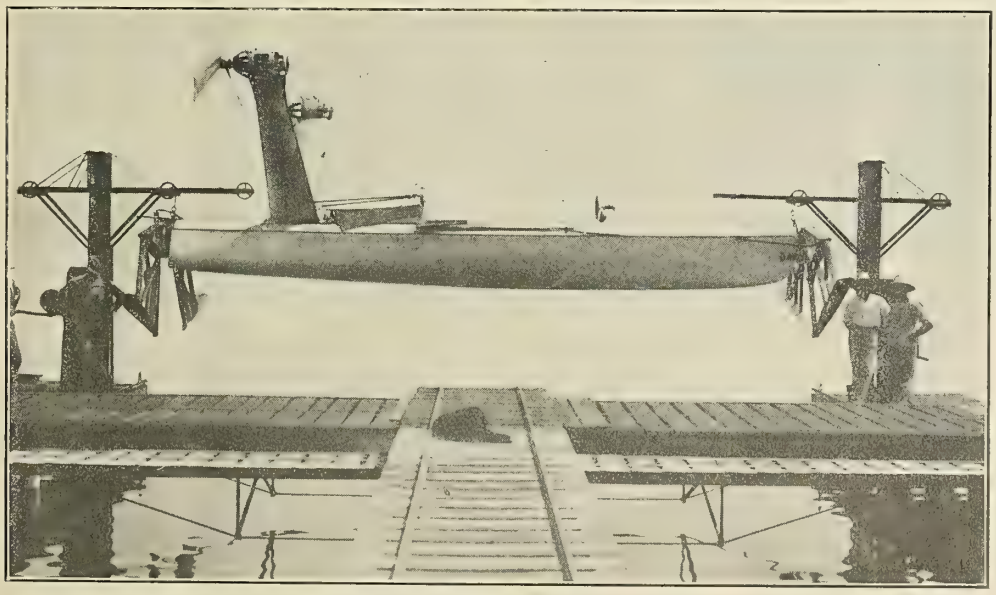
The aerial propellers, which operate only in the air, not in water, are of doubled aluminum plating, and weigh each about 12 kilos (26.4 pounds). Their pitch can be altered while running, and they can be reversed. They are mounted on frames of aluminum sheeting which, together with the shafts, gear, transmission, controlling devices, etc., weigh 300 kilos (660 pounds). The weight of the motor is also 660 pounds. Including all machinery, fuel, etc., and two men on board, the vessel weighs 1,500 kilos (3,300 pounds).

When running, the boat rises so that the hull is clear of the water, and at the high speed of 70 kilometers (43.5 statute miles) per hour, which has been obtained with this novel form of vessel, the hull is about 18 inches out of the water. One of the photographs shows the boat at full speed, supported solely by the "V"-shaped planes, the hull being clear of the water as described.

We are informed by the inventors of this boat that on

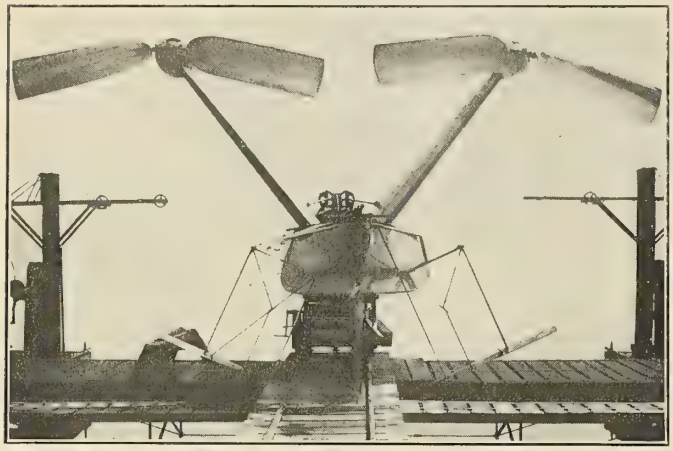


BOW VIEW, SHOWING THE BROAD, LOW, V-SHAPED PLANES.



BROADSIDE VIEW OF THE CROCCO-RICALDONI HYDROPLANE BOAT.

commencing a run, when a speed of about 10 kilometers (6.2 miles) per hour is attained, the bows begin to lift in the water, and the fore fins slowly emerge as the speed increases. At a speed of 25 kilometers (15.5 miles) per hour, the hull is wholly out of the water, only the flat portion near the stern skimming on the surface. At from 30 to 35 kilometers (18.6 to 21.7 miles) the boat is supported solely by the "V"-shaped planes; and at the highest speeds yet attained the hull is, as



STERN VIEW, SHOWING THE TWO SEPARATE INCLINED PLANES.

we have already stated, 18 inches out of the water. It has been found that waves of a height of 20 centimeters (8 inches) do not affect the vessel, as at the high speeds the hull stands quite clear of the tops of waves of this size. Trials over a course of 6 kilometers (3.73 miles) have been run, and sharp turns have been taken while running. After a certain amount of further experimental work, the inventors propose to put the boat through still more exhaustive trials, under as varied conditions as possible.

Overhauling the Marine Engine.*

BY E. J. WILLIAMS.

At a time when very few motor craft have been put into commission, a great deal yet remains to be done when the pleasant weather arrives. Lots of things are left undone. For instance, a great deal of care is expended in caring for the hull and fittings. The paint in most cases is burned and scraped off; calking removed from bad seams, and recalked and puttied; two coats of paint, at least, again put on; the varnish scraped off of the natural wood, and two coats of varnish again put on, after it is thoroughly sandpapered. Now, these details to the hull are all right, and the more attention you give to this work each season, the better boat you have after several years' use, and I might say even abuse. With all this hard, laborious task or precaution of making the hull of the boat presentable and seaworthy in every detail to the extent of the motorist's ingenuity and knowledge, yet the essentials or vitals are too often sadly neglected, through gross negligence. A pretty boat does not make a craft reliable and ideal in its full equipment; at least the writer has never found out the trick yet.

The vitals of a motor boat are its power equipment. The reliability of such a craft is dependent upon the proper performance of the power equipment. A little feature neglected here or there may cause untold worry at some critical time in the near future. Usually, though it might be well to say not always, because there are certainly a lot of good, sound, sensible thinking ones, all the attention given to the power equipment consists in installing a new set of batteries or recharging an old set, and wiping off the engine and polishing the brass parts; and this essential part of the power boat is ready for business again, according to the best of their knowledge. This has reference to the one-man control boat, in which all the work is done by the owner, who alone handles the boat, and on whom he has to depend for satisfactory results.

To the man who has the ingenuity or knowledge to completely overhaul and take apart the power equipment from beginning to end, the reward is naturally reaped in a good performance for the season, because parts requiring attention and replacing can be attended to, and endeavors made to have as good results as when the outfit was originally installed. Worn bearings can be determined, connecting rod, crankpin bearings, and crankshaft bearing tightened or made a perfect fit, piston rings loosened, or arranged properly, oiler and oil ducts cleaned, permitting a proper positive flow of lubricant, fuel tank and pipe washed out, carbureter cleansed, corrosion removed from all parts, ignition system installed anew, stuffing boxes repacked, all adjustments taken up, water circulation looked over and exhaust pipe overhauled.

Because many engines have no removable cylinder head, a great many have come to the conclusion that the engine should never be taken apart. No matter what the other fellow says, the liability of carbon or soot forming on the cylinder walls, near the piston's top center, is not eliminated with such an engine, and the only way of getting at it is to remove the whole cylinder up off the piston. The writer recently had a case of this kind wherein a second-hand engine had been installed in a new boat. The owner's inability to get the engine started caused him to seek some one's services to locate what he claimed was wrong adjustment of the carbureter. It was found that the flywheel could hardly be turned over by hand with the compression relief cock wide open, and it was a certainty that an explosion in a cylinder, with such a state of affairs existing, could not force the piston over the next half of the stroke. An explosion could be had each time the igniter snapped, but it was a plain case of piston binding at the top of the stroke. The only remedy was to slide the cylinder up and off, clean the carbon and soot from the top of the piston bearing surface, see that the rings were free, and put it back, when it worked perfectly.

When the power boat is laid up in the fall, the engine should at least be partly cared for, as the winter is liable to work wonderfully peculiar ravages in the way of rust. In the spring the old ignition equipment wires should be removed, especially if the boat is used on salt water, and new wires strung, unless the wiring is located in the cabin, and of a good size (say number 14 B. & S. gage) and properly insulated. The writer has seen an unprotected piece of wire of number 18 gage corrode to the thickness of a hair by being in contact with salt air, even under cover from spray. Another place where corrosion is liable to appear is at a point where an iron staple holds the wire in place. The insulation may have been broken so that the rust from the iron staple reaches the copper wire, and the salt air starts up a chemical action resulting in a heavy corrosion. The wire may eventually give way or produce such a resistance at this point as to require a great deal more current to effectually operate the coil, or give a satisfactory spark to ignite the mixture.

To offset any of these possibilities and take no chance on what is an uncertainty, the only safe method is to rewire the whole thing if the craft is an open boat. Lead-armored wire gives the best results, but is seldom used. If more ignition installations contained such a grade of wire, the possibility of such a trouble occurring in the wiring system for several years to come would be entirely done away with. Many installations contain only a grade of common electric bell or annunciation wire. If lead-covered wire is unobtainable, safety wire, consisting of, first, a soft rubber insulation surrounding the wire,

* *The Gas Engine.*

and over this a woven cloth soaked in wax or an insulated compound, can be purchased from any electrical contractor. The secondary wire in jump-spark ignition in open boats is invariably a source of annoyance from severe shocks when coming in contact with same. Hard-rubber tubes slipped over the secondary wire, the ends being made tight by binding with insulating tape, give good results. Flying spray is another incumbrance besetting the pleasures of motor boating, if it happens to touch the spark plugs. While very few persons appear to appreciate the usefulness of weather-proof spark plug protection, more will eventually yield to the notion that it is a more sane idea than a mere fad, which appears at present to be the general opinion.

All binding posts on the coil, engine, timer, switch, batteries, etc., should be brightened with fine sandpaper, so as to give a good contact. All contact points on the timer, coil and switch should also be brightened in the same manner. Adjustments on the timer should be made, and all springs made to operate freely, and new ones put in where required. The vibrating spring on the jump-spark coil ought to be taken off and all rust removed, so that it has a free action. Renew any worn springs on the make-and-break ignition mechanism, and brighten the spark points inside of the cylinder.

Galvanized iron fuel tanks should be thoroughly scrubbed out each spring. Annealed copper tanks for gasoline are to be preferred to galvanized iron, owing to a white sediment from the latter finding its way to the carbureter. One length of annealed copper or hard lead for fuel supply pipe, with soldered connections, is also highly recommended. The circulating water pump should be taken apart and all corrosion removed. Take apart all check valves and remove the rust invariably found therein, so that the check has a good seat. If the cylinder head is removable, take it off and remove whatever scale and rust from the cylinder water jacket that it is possible to get off. A clean jacket does its work effectively.

Look over the muffler and exhaust pipe line and remove any broken or thin pipe or fitting. While appearing perfectly solid to the eye, a light tap with a hammer often goes through a shell in the exhaust pipe line, the thinness of which will surprise you, especially if your overflow circulating water empties into the exhaust line. If any portion of the exhaust pipe contains an asbestos covering, look it over, and if burned to any extent whatever, remove the section and put in a new piece. Take no chances that it will last the season out, or you may find your boat on fire, with damaging results.

If the engine is a four-cycle outfit, look over the valves and valve seats, springs, lifts, etc. Grind in whichever ones require it, preferably all, so that a perfect seat is assured. Pour kerosene (paraffin) oil on the valve stem guides and springs, and thoroughly clean all parts pertaining thereto, so that a free valve movement is obtained. If any valves require renewing in any way, don't neglect it. Before the boat goes overboard be sure and see that the strainer of the outboard water circulation is clear of any foreign substance. Sliding the boat over the sand, mud, or dirt may clog up the inlet pipe. Small details should be attended to before the boat goes overboard, or it is "nine chances out of ten" they will be forgotten. I might go on for some time telling things that were right and wrong, but the foregoing should jog the memory of those interested, so that they will see the importance of having the power equipment right. One more reminder;—get a new piece of chamois to strain the gasoline (petrol), or wash out the old one with soap and water and let dry, and when the boat is ready to go into the water stow away a bucket of sand to be used as a fire extinguisher,—you may be able to help someone else in case of a fire.

Eads Johnson, formerly of James Shewan & Sons, New York, has taken charge of the New York office (12 Broadway) of the New York Shipbuilding Company, Camden, N. J.

A Small Motor Tender.

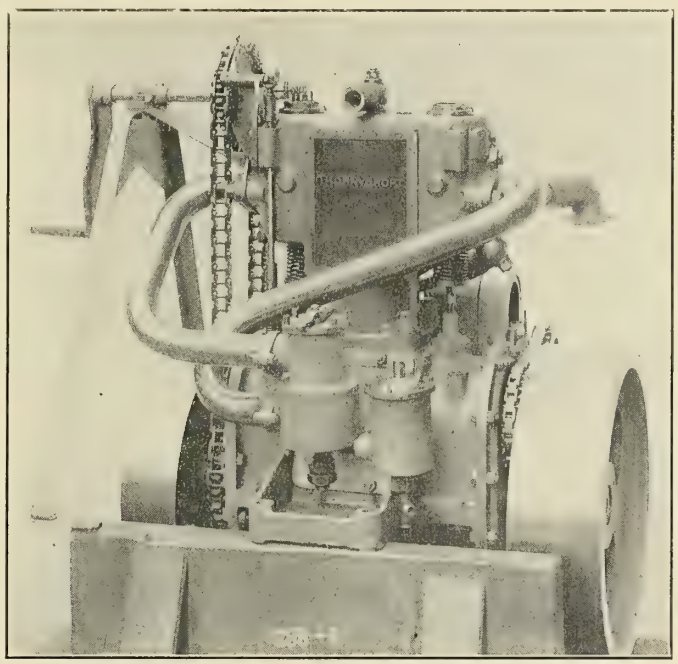
John I. Thornycroft & Company, Ltd., Chiswick, built last year for Mr. Longbottom's steam yacht *Rubicon* a particularly smart looking tender, carvel built of mahogany, close jointed and varnished inside and out. The decks forward and aft are also of mahogany. The floors are covered with American elm gratings. The length is 19 feet 6 inches, beam 5 feet, and the maximum depth 3 feet 8 inches.

The power is transmitted by a Thornycroft 6 brake horsepower motor, through a reversing gear to a Thornycroft solid propeller of large diameter, specially designed for towing. It

MOTOR TENDER FOR THE STEAM YACHT RUBICON.

was anticipated that a towing speed of about 4 miles per hour could be easily maintained, and in view of the fact that the *Rubicon* is of 90 tons yacht measurement, this is a very satisfactory performance.

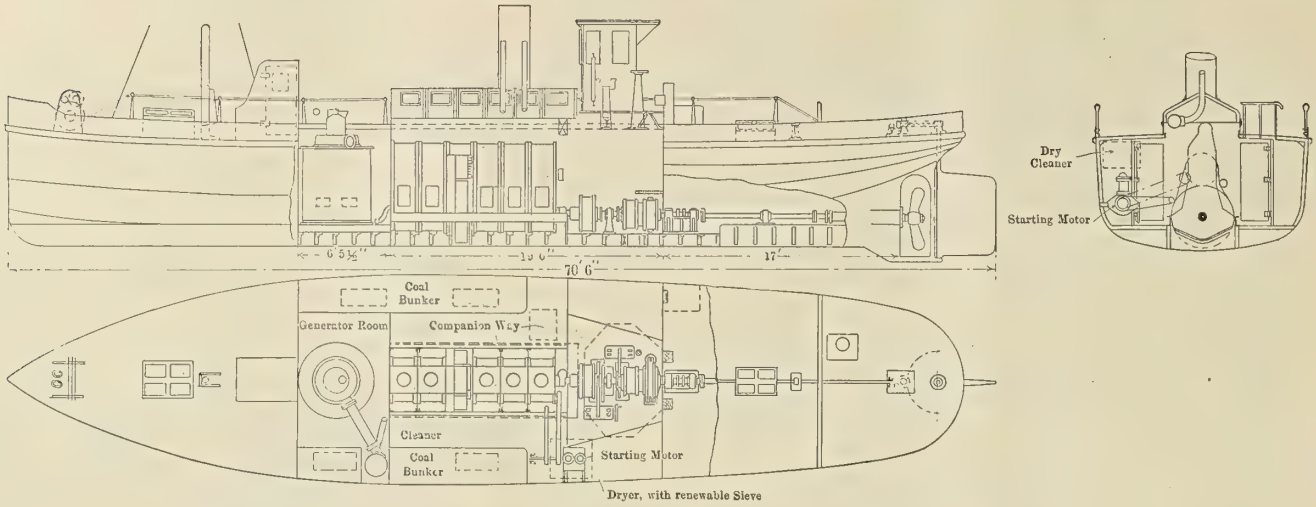
The fuel tank is of brass, and all petrol (gasoline) and water pipes are of solid drawn copper. The motor is completely covered and protected from rain and spray by a neat



SIX-HORSEPOWER MOTOR IN TENDER TO STEAM YACHT RUBICON.

mahogany casing. The boat is provided with two hoods, one over the engine space and the other over the cockpit, each fitted with talc lights.

Slings are provided for hanging in davits, and it is owing to the space and weight being limited for this purpose that special provision has had to be made to keep weight down to a minimum, while still leaving a good margin for strength. The contract stipulated 13 cwts., but the builders found they had ample margin, the actual weight being about 12 cwts., while the staunchness and seaworthy qualities were very apparent, and in no way impaired by the light construction. A



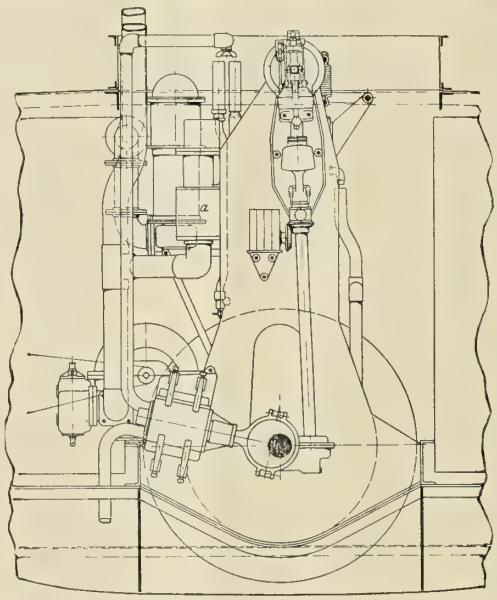
THE TUG WILHELM, PROPELLED BY A SUCTION PRODUCER PLANT ON THE CAPITAINE SYSTEM.

boat of this type would be equally useful for up-river work, or cruising in more or less sheltered waters, and its moderate initial cost, economy in fuel and maintenance should recommend the type strongly to those in search of a small, well-built and handy motor boat.

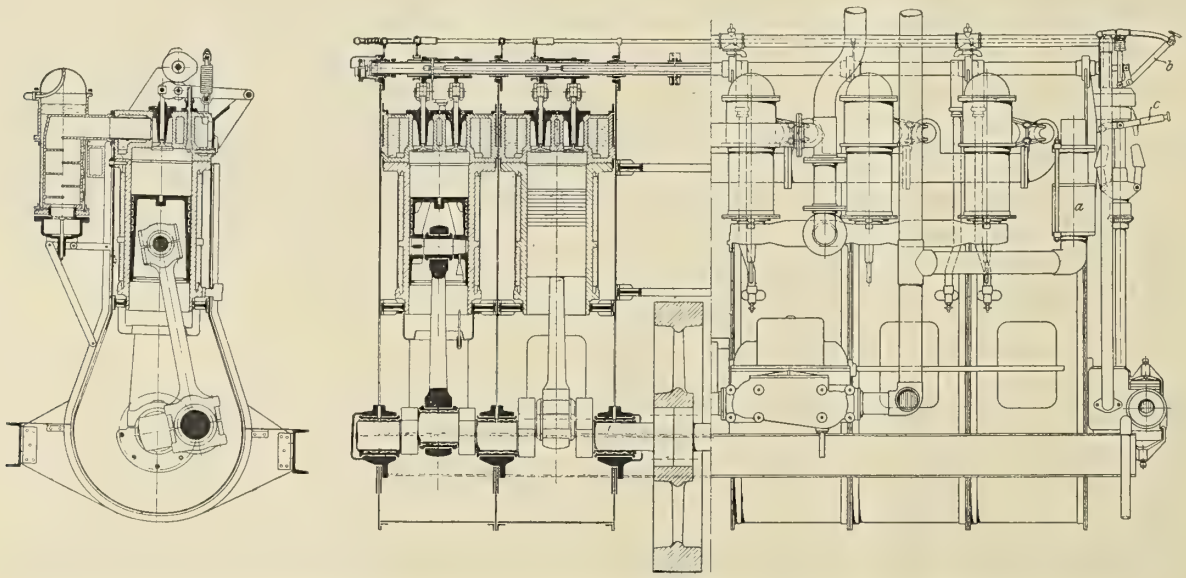
The Producer Gas Towboat Wilhelm.

This is a boat built by the engine and shipbuilding plant of Fritz Luennemann, in Ruhrort, and provided with a suction gas motor of from 160 to 175 horsepower, working on the Emil Capitaine system.

The vessel has a length of 20 meters (65 feet 7 inches) and breadth of 4.5 meters (14 feet 9 inches). Three watertight bulkheads divide the hull into four compartments. The forward compartment is occupied by the captain and helmsman; the second and third compartments by the machinery, including the producer, the five-cylinder engine and the reversing gear; while the after compartment is devoted to the crew, and below it runs the propeller shaft. The engine room, which is the third compartment from the bow, has a length of 5.95 meters (19 feet 6 inches). Besides the reversing gear for the propeller, this contains also the steering apparatus, carried up above the deck in a small pilot house. Aside from the skylight and companion forward, engine hatch and pilot house amidships, and a small skylight for the crew space, the



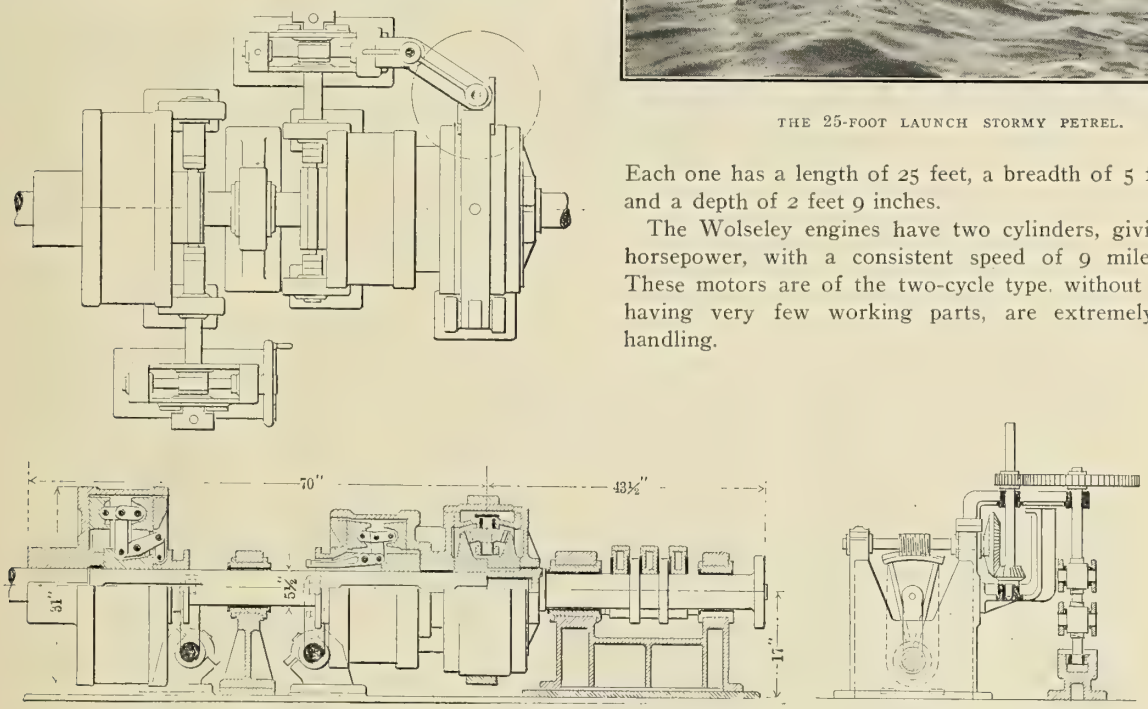
AFTER END VIEW OF ENGINE, SHOWING CARBURETER AT *a*.



TRANSVERSE AND PARTIAL LONGITUDINAL SECTION OF THE FIVE-CYLINDER ENGINE, WITH PARTIAL LONGITUDINAL ELEVATION.

deck is quite clear of obstruction. Fuel is carried in two wing bunkers alongside the producer and engine.

The engine cylinders are mounted on a frame of iron plates, which is stiffened and strengthened with angle irons. Each of the five cylinders has a diameter of 300 millimeters (11¾ inches) and a stroke of 400 millimeters (15¾ inches). The fly-wheel is between the first two cylinders and the last three. The exhaust pipes are placed on the sides of the cylinders, and are fitted with mufflers, consisting of cylinders filled with baffle plates and jacketed with water. This water is thus evaporated for the use of the generator in its function of providing the gas. Ignition is governed by adjustable cam wheels located upon the tops of the cylinders. A small starting engine is provided in the shape of a two-cylinder benzine motor, which is connected with the main engine by a leather belt. This motor also drives a centrifugal pump, which controls the gas coming from the generator through the cleaner before passing it into the cylinder. The working volume in the cylinders has practically no clearance space. All the exhaust channels and valves are well cooled on all sides, so that radiation from the engine is very slight.



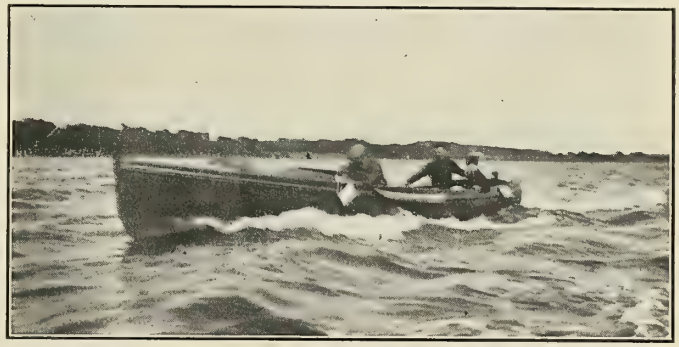
REVERSING CLUTCH FOR THE PROPELLER-SHAFT COUPLING ON THE PRODUCER-GAS VESSEL WILHELM.

Each exhaust valve consists of a cast body with a malleable iron jacket; between the jacket and the body is cooling water, which, again, is vaporized for the use of the producer. It is said that a very short time is necessary between the starting of the producer and the production of the gas, giving full power to the engine. When the motor runs light there is a coupling between the motor and the shaft which can be released by means of a hand-wheel on the deck. A second coupling aft of this one serves as a reverse gear for the propeller.

For firing the generator, usually the best anthracite nut coal is used, costing about 22 to 23 marks ($5.25 to $5.50; 21/6 to 22/6) per ton. In a trip last spring with a load of 300 tons, 60 kilograms (132 pounds) of coal was burned per hour. The generator was cared for only once during each hour. The operation of the engine proved itself very regular under heavy load. The speed of the ship, empty, against the stream is about 22 kilometers per hour (12 knots).—*Zeitschrift des Vereines deutscher Ingenieure.*

The Stormy Petrel.

This is one of half a dozen vessels built last summer by Summers & Payne, Ltd., Southampton, for members of the Motor Yacht Club. They are very complete little cruisers, carvel built, with a short deck fore and aft and with two hoods, enabling them to keep passengers dry at all times.



THE 25-FOOT LAUNCH STORMY PETREL.

Each one has a length of 25 feet, a breadth of 5 feet 9 inches and a depth of 2 feet 9 inches.

The Wolseley engines have two cylinders, giving 10 or 12 horsepower, with a consistent speed of 9 miles per hour. These motors are of the two-cycle type, without valves, and, having very few working parts, are extremely simple in handling.

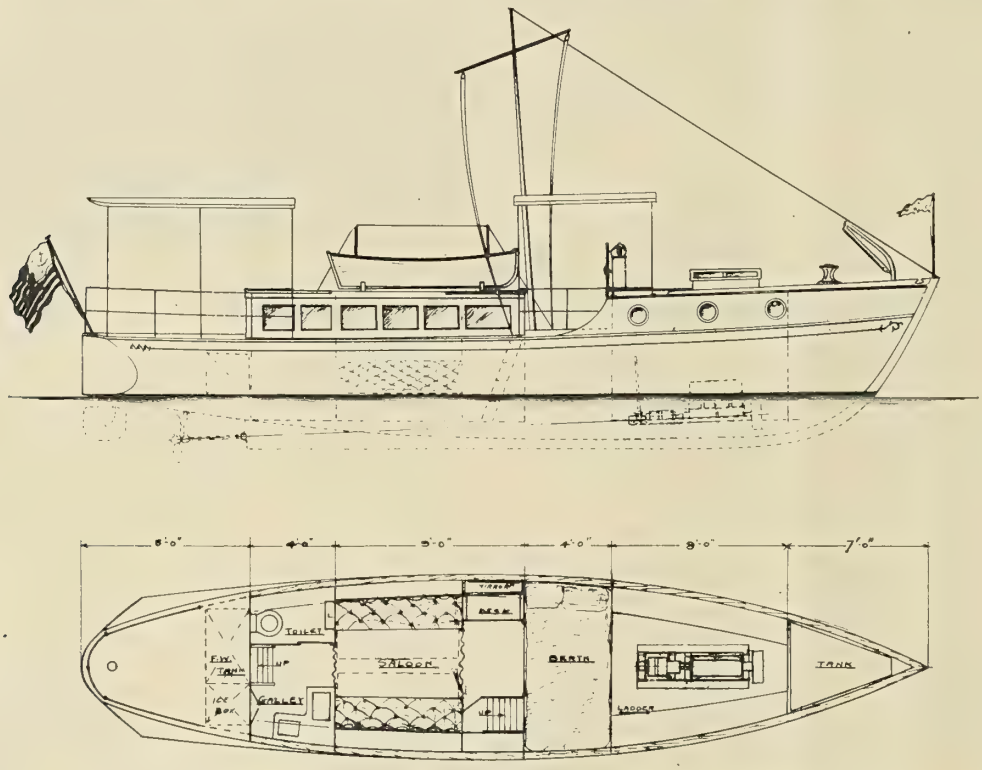
A Forty-Foot Cruising Cabin Launch.

One of the most striking exhibits at the New York Motor Boat Show was a high freeboard cruising launch built by the Racine Boat Manufacturing Company, Muskegon, Mich. The freeboard is such as would make this boat especially valuable for use in off-shore cruising, and against a heavy sea, as will be amply attested by the drawing. The length of the hull over all is 40 feet, with a beam of 8 feet 9 inches and a draft of 3 feet.

The stem and stern posts, keel and transom are of white oak, thoroughly riveted together, and with galvanized iron fastenings. The frames are of specially selected straight green white oak, bent to shape in a steam bath and fastened to the white oak floor timbers, which are riveted through the keel. The entire hull is planked with 1-inch Michigan white cedar, except for the garboard and sheer strakes, which are of oak. The skin fastenings are brass screws. Planking butts are reinforced with oak doublings, while the clamps are of yellow pine. The engine foundation is a heavy structure of white oak, being specially designed for the limitation of vibration. The decking for the cabin is of white cedar laid fore and aft and covered with 10-ounce duck, cemented on. An oak foot rail is fitted on either side, with an after deck and waterways of oak.

The forecastle is formed by an upward extension of the hull framing and planking, with a roof of beaded and matched cedar, covered with heavy duck and made waterproof with lead paint. The edges of the deck are covered with oak molding. The deck beams are of oak, with a slight crown. In the forecastle are located the gasoline tank (forward of the collision bulkhead), the chain locker and the engine room. A pipe berth on each side above the engine furnishes accommodation for two engineers. Directly above the engine is a skylight, with bronze fittings and protecting rods. This room has

Electric lighting is provided by an Apple dynamo, driven by a friction gear from the fly-wheel of the engine. To supplement the dynamo there are two storage batteries, each with a capacity of 60 ampere-hours at six volts. The lighting is provided by twelve 6-volt lamps of 4 candlepower each. The equipment includes also polished brass Fresnel sailing lights, brass binnacle, a mast with a stationary yard for signaling purposes, two anchors with a davit for their operation, and a 9-foot canvas-covered tender carried on top of the cabin trunk, and handled by galvanized iron davits on the port side.



FORTY-FOOT CRUISING CABIN LAUNCH, BUILT BY THE RACINE BOAT MANUFACTURING COMPANY.

six hinged bronze port lights, thus affording ample light.

The stateroom just aft of the engine room has two smaller port lights, one on either side, and opens from the saloon, in which are two sofa berths and a folding table. The exterior finish of the saloon, which projects above the after deck of the boat, is in mahogany. The interior is white enamel with mahogany trim. Six square windows are fitted on either side, being hinged at the bottom. The roof beams are of mahogany, with white cedar panels finished in white enamel between them. Plate-glass mirrors are fitted on the bulkheads leading from the saloon to the stateroom and to the galley and toilet respectively. Lockers are fitted under the sofas, the latter being upholstered, back and seat, in green plush. Green tapestry curtains are fitted at each of the two exits from the saloon.

Aft of the saloon is a compartment containing the toilet on the port side and galley on the starboard. The latter is equipped with a two-burner oil stove, pump, dish rack, sink and locker, while an icebox under the after deck serves for the storage of provisions. To the port of the icebox is the fresh-water tank, also under the after deck.

The engine, which is of 20 horsepower, is of the 4-cycle type with four cylinders, an inboard reverse, and turns a solid three-bladed propeller. The engine is water jacketed throughout, is fitted with a float-feed carbureter, jump-spark ignition, and a rotary pump and bilge discharge. The reversing lever and throttle control are fitted at the steering wheel, so that one man can handle the entire equipment.

The Power Lifeboat Banfield Creek.

The Electric Launch Company, of Bayonne, N. J., has completed a power lifeboat for the Canadian Life Saving Service, which is said to show qualities far in advance of any boat previously constructed for this purpose. The plans and specifications were prepared by Capt. C. H. McLellan, R. C. S. (retired), formerly inspector of the United States Life Saving Service, and call for a boat 36 feet over all, 8 feet 1½ inches beam, built almost entirely of mahogany and fastened with gunmetal and copper, no iron being permitted.

It is diagonally planked in two layers, with canvas between, and is self-bailing and self-righting, with the crew lashed to the thwarts. The boat is divided into eight watertight compartments below the deck, and each compartment is filled with copper air cases, eighty-two in all. It is lug rigged with foresail, mainsail and jib, with hollow masts and gunmetal centerboard, and is also fitted for ten oars.

A 35-40-horsepower Holmes auto-marine, six-cylinder, four-cycle, gasoline (petrol) motor is installed in the after end compartment, which gives a speed of 9¾ miles per hour with 650 revolutions. The controls are so arranged on the outside of the compartment bulkhead, in recessed boxes, that the motor can be readily managed from the outside when the compartment is closed watertight.

A fuel tank of 125 gallons capacity is located in the lower hold just forward of the centerboard trunk, and an auxiliary fuel tank of 25 gallons capacity is placed under the turtle back of the forward end compartment, into which the fuel is

pumped from the main tank as required. The fuel pipe to the motor leads from the auxiliary tank outside along the garboard. A glass in the forward bulkhead enables the height of the fuel to be seen in the sight tube attached to the auxiliary tank.

The engine is fitted with jump spark ignition, the current being supplied by the Apple ignition apparatus, which also furnishes current for a stationary and drop light in the motor room and a light by the sight tube of the auxiliary tank forward. The whistle is operated by air, compressed by the motor. The boat is steered from a wheel, which can be instantly detached from the rudder head, in case the steering oars are to be used in a bad surf, and the rudder is to be triced up.

The boat has been sent to Victoria, B. C., and from there taken to Banfield Creek, Vancouver Island, which will be its station. This is one of the most dangerous locations for shipping on the Pacific Coast, being nearly opposite Cape Flattery, and is near the scene of the disastrous *Valencia* wreck, which occurred a few years ago. It is also near the point where international co-operation in lifesaving is soon to be a reality, with an American revenue cutter on duty in Neah Bay, and wireless stations along the coasts of Vancouver Island and the State of Washington.

A 16-HORSEPOWER FRENCH MOTOR BOAT.

THIRTY-SIX FOOT LIFEBOAT, BUILT FOR CANADIAN GOVERNMENT, AT BAYONNE, N. J.

A French Cruiser Motor Boat.

The cruiser *Delahaye IV* won the second prize for cruisers of 6.5 meters (21.3 feet) at the Chamtionnat de la Mer, and also at the D'Evian regatta for cruisers of 8 to 12 meters (26.2 to 39.4 feet). It has also won first prize for the same class of cruisers at the Nantes regatta, also at Coupe de Troudille and the Regates de Lucerne. At the Regatta du Havre this boat won second prize over a course of 100 miles, and first prize for cruisers 8 to 12 meters at the Regates du Lac-Majeur. This remarkable little French cruiser has an engine of only 16 horsepower, of the vertical four-cylinder type, having a normal speed of 1,250 revolutions per minute. The engine occupies a floor space of 1,250 by 500 millimeters (49¼ by 19¾ inches).

A Twenty-five Foot Semi-Cabin Cruiser.

The photograph shows the 25-foot cruiser *Hawk*, built by MacLaren Brothers, Sandpoint Yard, Dumbarton. The general arrangement of this launch shows a small store room in the forepeak; a cabin, including two sofa berths and folding table; an open cockpit, in which are located the engine (under a portable cover); a folding table and the steering position, and the after peak, in which is the fuel tank. On the forward deck, just ahead of the cabin turtle back, is a watertight hatch, giving access to the cabin and the stores. The length is 25 feet, beam 6 feet, depth 3 feet 3 inches and maximum draft 1 foot 8 inches.

The engine is a 6-horsepower Scout motor, with two cylinders, and operates the propeller shaft by means of a universal

THE MOTOR CRUISER HAWK, 25 FEET LONG.

joint, the engine crank shaft being horizontal. Reversing is accomplished by means of a lever and slide clutch operated from the steering position. This enables the entire management of the vessel to be placed under the control of one man. There is a bilge pump worked by the motor and put in action by means of a lever. The floor of the cockpit is covered with linoleum, while the motor, which projects beneath this floor, is fitted with a metallic tray.

The World's Shipbuilding in 1907.

Figures from various sources have been compiled showing the shipbuilding of the world during the year lately concluded. The various methods of compiling the figures have resulted in considerable variations in the totals given. The apparently most reliable figures which we have been able to find show an aggregate of 2,966,156 gross tons of merchant vessels, of which 1,654,533 tons, or 55.8 percent, were launched in the United Kingdom and the colonies. The total for the British Isles appears to be 1,620,853 tons, of which 139,442 tons represent the Irish construction (mainly Belfast); 840,995 tons were constructed in England, and 640,416 tons in Scotland; the construction in the colonies was 33,680 tons. In each case warship figures are omitted. Construction in other countries includes:

	1906.	1907.	Lloyd's.
United States.....	393,291	502,508	474,675
Germany	356,128	311,784	275,003
Holland	115,152	152,371	88,623
France	59,837	83,105	61,635
Japan	95,088	66,015	66,254
Italy	41,646	53,033	44,666
Norway	56,023	51,523	57,556
Other countries....	106,821	91,284	55,343

First on the list of separate yards for the year is William Doxford & Sons, Sunderland, with 91,254 tons and 40,063 horsepower, as compared with 90,907 tons and second rank in 1906. If, however, we include the several plants of the American Shipbuilding Company on the Great Lakes, we find that this company has constructed a much larger tonnage than any other in the world, the figures being 205,233 tons and 66,300 horsepower in 1907, and 195,930 tons in 1906. This includes seven yards, of which six were in operation in 1906. The largest of these yards accounts for 54,788 tons, which figure is exceeded by six British yards, including Doxford & Sons, Swan, Hunter & Wigham Richardson (80,573 tons), the Elswick yard (74,228 tons), Harland & Wolff (72,412 tons), Russell & Company (71,705 tons), and Workman, Clark & Company (63,245 tons); and also by the Great Lakes Engineering Works, Detroit (55,485 tons). The largest construction in Germany was by the Vulcan Works, Bremen, with 49,431 tons. No other yard in the world, outside of Great Britain, reached as much as 40,000 tons.

Of the total construction during the year only six vessels exceeded 10,000 tons, and none of these reached 13,000, while last year we had the two mammoth Cunarders of over 30,000 tons each, as well as the *Adriatic*, of almost 25,000 tons. Three of these largest ships are from the yard of Harland & Wolff, Belfast, while two others are from the Fairfield Company, Govan. The sixth—third in order of size—was built by Barclay, Curle & Company, Whiteinch.

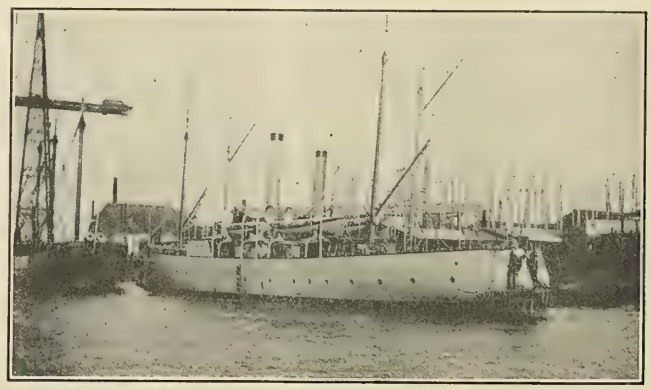
Figures given by Lloyd's Register differ somewhat from those collected from other sources. The annual summary of this Register states that 752 steamers of 1,581,521 gross tons, and 89 sailing vessels of 26,369 gross tons, were launched during 1907 in the United Kingdom. This makes a total of 841 vessels and 1,607,890 tons. This Register gives figures for merchant shipbuilding in other countries, as shown in our table, under their name. In each case it will be found that there is a marked difference from the figures collected from other sources, the total given for the world being 2,778,088 tons.

It might be of interest to compare some of the figures given in Lloyd's table of shipbuilding during the past sixteen years. In 1892 the total construction is given as 1,358,045 tons, of which the construction in Great Britain amounted to almost 82 percent; that in the United States was only 4.6 percent, while German construction was about 4.8 percent of the total. In 1897, the total construction is given as 1,331,924 tons, this having been a particularly lean year. Of this total, British ships accounted for 71.5 percent, American for 6.5 percent, and German for 10.5 percent. In 1902, out of a total construction of 2,502,755 tons, the British figures accounted for 57 percent, American for 15.1 percent, and German for 8.5 percent. In 1907, out of a total of 2,778,088 tons, British construction accounts for 58 percent, American for 17.1 percent, and German for 10 percent.

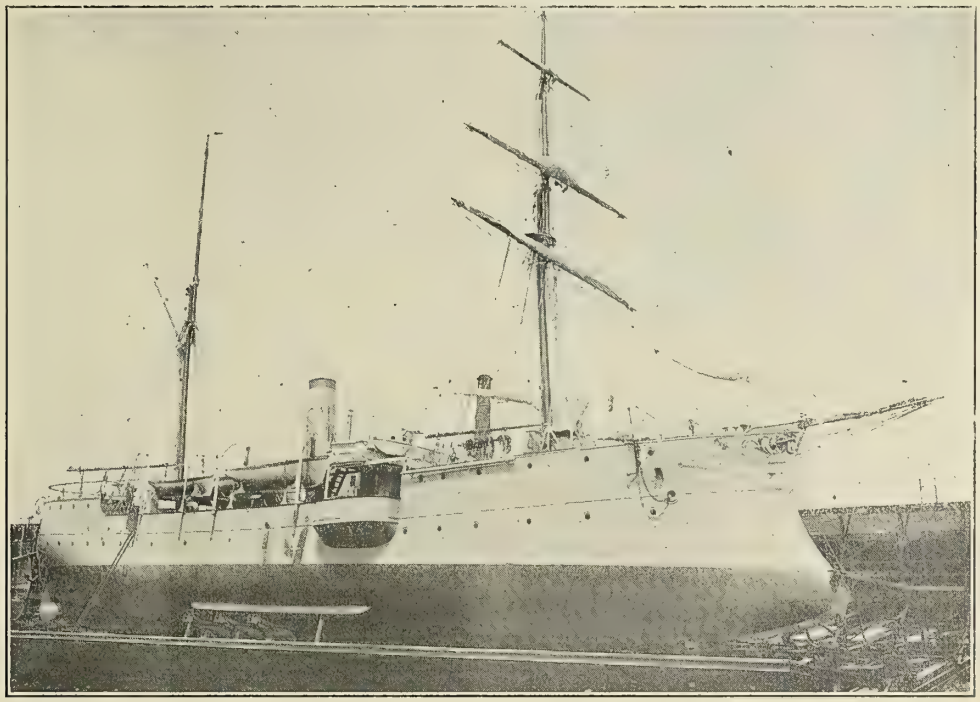
Warship construction is given by Lloyd's as 142 vessels of 321,211 tons displacement. Adding this to the merchant figures, the total construction for the world appears to have been 1,930 vessels, of an aggregate of 3,099,299 tons. Of men-o'-war, thirty-six ships of 134,475 tons were built in the United Kingdom, all except three, of 1,070 tons, being for the British Navy. Construction in other countries include sixteen in Japan, of 61,100 tons, of which six of 3,900 tons were for China; twenty-four in France, of 35,289 tons, of which seven of 1,695 tons were for Turkey; fifteen in Russia, of 34,617 tons; twelve in Italy, of 25,154 tons; twenty-one in Germany, of 16,200 tons, of which two of 700 tons were for Greece, and two of 700 tons for Russia; five in the United States, of 11,590 tons, and thirteen in other countries, aggregating 2,786 tons.

New Coast Guard Boats for Turkey.

A scout and five gunboats for the Turkish government have recently been completed at the Chantiers de la Loire. These



TWO SMALL TURKISH GUNBOATS, BUILT IN FRANCE.



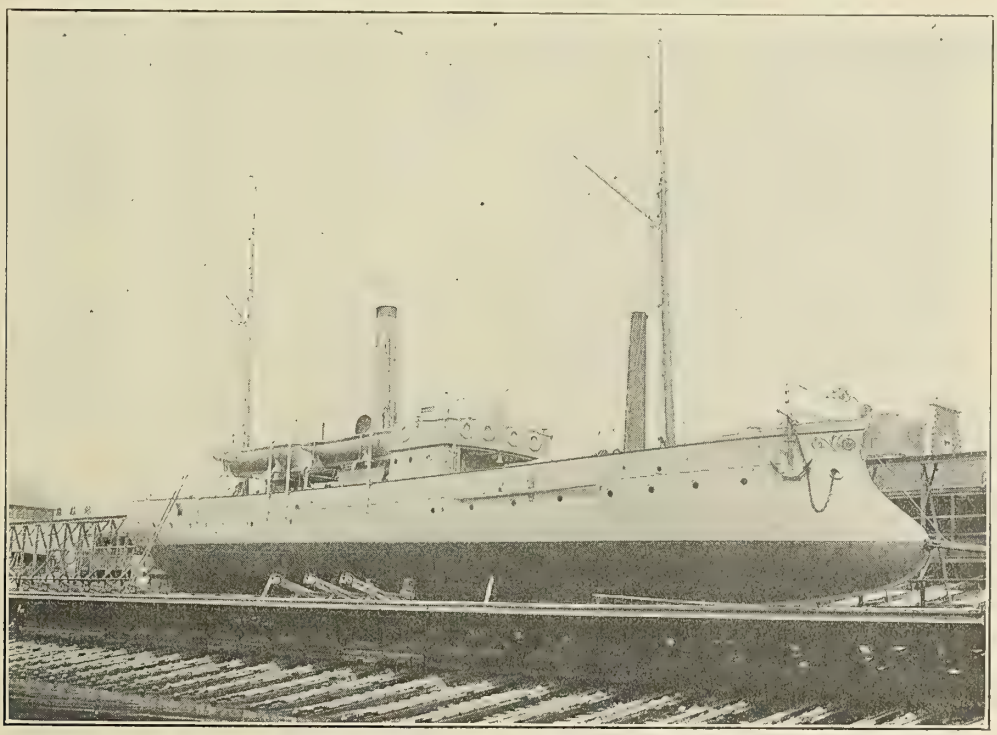
THE TURKISH COAST GUARD CRUISER MARMARIS ON SLIPWAY.

steamers are designed for coast guard work, and for the suppression of piracy and smuggling, and the settlement of varinous disputes along the Turkish coast in the Red Sea and the Persian Gulf. The scout has been named *Marmaris,* while the first of the gunboats has been called *Seddlibaschir.* These two types of vessels are quite different from each other, and are not at all in line with present up-to-date practice of the larger naval powers. For their own purpose, however, they will doubtless prove satisfactory.

The *Marmaris* has an armament including four 9-pounder and two 1-pounder guns and one 18-inch torpedo tube. She has a crew of twelve officers and fifty-four men. The gunboats are arranged for three 3-pounder and two 1-pounder guns with one torpedo tube, and are manned by nine officers and thirty-eight men.

The general dimensions of the two types are as follows:

	Marmaris.	*Gunboat.*
Total length	172 ft.	154 ft.
Extreme beam	24 ft. 7 ins.	18 ft. 10 ins.
Depth	13 ft. 9 ins.	11 ft.
Draft	11 ft. 10 ins.	7 ft. 11 ins.
Displacement in tons	422	309
Indicated horsepower	950	480
Speed in knots	14.81	12.45
Radius of action	2,000 miles	1,200 miles
Steam pressure	199 pounds	199 pounds
Scotch boilers	2	1
Sail area, in square feet	5,160	2,205



THE TURKISH COAST-GUARD GUNBOAT SEDDILBASCHIR ON SLIPWAY.

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Direct Steamship Service Between the Two Americas.

For many years there has been a large item of complaint on the part of merchants in the United States regarding the steamship service between that country and the countries on the east coast of South America. Strange as it may seem, it has usually been speedier and not more expensive to send mail, travelers and merchandise from the United States to England, and thence to Brazil and the Argentine Republic. The two latter-named countries are just about equally distant from the United States and England, and the strangeness of the whole proceeding lay in the necessity for sending whatever had to be sent across three thousand miles of the stormy North Atlantic, and then starting them on a journey of approximately the same extent as would have been the case had the shipment been made direct.

One of the main arguments brought up in the Congress of the United States in favor of a subsidy bill, be it mail subsidy or shipping subsidy, has been based upon the facts mentioned above. It is, naturally, very disconcerting to the pride of the average American merchant to be placed, as it were, in such subserviency to his British contemporary; and the element of time, always of much importance in matters of this kind, has made the argument a very strong one. The same subject is up again in the present Congress, and bids fair to win a limited modicum of success, in so far as the carrying of the mails is concerned. Whether or not this will result in any considerable accretion to the number and size of steamships plying between New York and Rio de Janeiro and Buenos Ayres remains to be seen, but the presumption is all in its favor.

Our first article this month covers a description of the first of a line of steamers, under the British flag, in which this identical service is to be carried on. Other steamers under construction will make up a fleet with which it is proposed to make two sailings per month in each direction, and thus maintain regular, systematic and comparatively rapid communication between the two halves of the American continent. This service is expected to be very good, so far as it goes; but the developments of the next few years will unquestionably show the need for a great augmentation in the number of ships sailing, and the frequency of opportunity to make the trip. In other words, it is highly probable that the demand will require sailings at least once a week, and possibly as often as twice a week. It is for this reason that the bill at present before Congress is being pushed, with the idea of placing at least a fair proportion of these vessels under the flag of the great nation most largely concerned in the trade. Such a consummation could be effected only by the construction in American yards of ships designed and destined for this particular service, and of sufficient number to bring the service up to the point where supply meets demand. This would serve as a very effective stimulus to shipbuilding on the Eastern coast of the United States, and, as such, would be heartily welcomed by all interests concerned.

Motor Boats.

The present number, as has been the case once or twice before with March numbers, is very largely given up to the subject of small boats propelled in the main by internal combustion engines. This is an industry which has grown from very small beginnings to a present enormous business; and while in general it is more or less removed from shipbuilding, so far as the large units are concerned, yet the general problems involved are pretty much the same, and much may be learned from experiments on these small vessels which will be of aid to the designer of large ones. Not the least of these features is in connection with the use of internal combustion engines operating upon suction

producer gas generated alongside the engine. One of the articles this month is a brief description of such a small vessel; and many have been the attempts to inaugurate such a system of producer gas plants and engines as would prove available for the propulsion of large vessels. This is not a new proposition, but up to date success has not been very marked, and no vessel of any considerable size has been fitted with the apparatus. Much has been done, however, in the way of experimentation, particularly upon these small plants, and all of this is simply a case of pioneering which will bear fruit in the near future in the application of this form of power to larger vessels.

Motor boats may be in general divided into three principal classes—those intended for business purposes, those intended for cruising and those intended for racing. The general principles underlying all of these classes are necessarily the same, but the details are worked out along totally different lines. The cruising vessels have broad and comparatively heavy hulls, where the racing vessels are narrower and with weights reduced to a minimum. The cruisers have engines of moderate power only, often of considerable weight in the interests of economy of operation, steadiness and reliability; where the racer is provided with engines of great power, and here again weights have been reduced to a very low figure. The racer is almost invariably an open boat, or one covered with a flush deck; the cruiser is frequently of this same type, but is perhaps more frequently fitted with some sort of a cabin, either under a turtle back forward, or reaching up amidships in the form of a deckhouse, the larger portion of which is below the main deck.

The business boat has many of the characteristics of each of the others, and, under certain conditions, very much resembles either the one or the other, depending upon the particular service to which it is to be applied. In many cases, however, we find a totally different sort of a proposition,—such, for instance, as in boats designed for oyster fishing, or for deep-sea fishing generally. In these cases we have a broad, flat boat of very little shapeliness, propelled by a small engine intended to develop a speed usually of not more than six to eight miles per hour. This engine is located in the extreme stern, and very little attention is given to whether or not the screw shaft has a considerable rake. The propeller is not operated at anything like its best efficiency, but gives such service as is demanded much more cheaply than it could be obtained with any other known form of propulsion except the wind. Most of these boats are fitted also with some provision of sails, which are used whenever the wind is available, and from this point of view the engine is largely an auxiliary. In any event, however, the boat is distinctly a motor boat, and is one whose usefulness is beyond question.

In addition to the regular forms of motor boats, there are other vessels propelled by internal combustion engines whenever occasion demands it. These are auxiliaries, intended usually for propulsion by sails, and fitted with the motor simply as a means of proceeding in a calm or against head winds. A conspicuous example of this type is the large schooner *Northland,* described at page 362 of our September, 1907, number. This is said to be the largest auxiliary schooner in existence, and is provided with a six-cylinder engine of not less than 500 horsepower. This vessel is of over 2,000 tons gross, and carries 9,000 square yards of canvas, upon which, in general, reliance is placed for propulsion. When necessary, however, the engine is found to give excellent satisfaction, the speed being from 5 to 6 knots, even under adverse circumstances. In this particular case, there are also smaller engines of the same general type, which are used for generating electricity. The electrical power is used for operating elevators, thus facilitating the handling of the cargo; for lighting the schooner electrically; and for operating a searchlight. These are all decided innovations in coastwise schooners, and illustrate rather forcibly the great utility of the small engine for auxiliary purposes upon vessels of this type.

A kindred use of internal combustion engines is in their fitting to large sailing yachts, be they sloops or schooners. Several such vessels have had these engines installed, either at the time of building or at a subsequent date, and much satisfaction has been derived from their use, whenever occasion has demanded the propulsion of the vessel by means other than her own sails. In other cases, where it was not found feasible to fit the auxiliaries, a small boat has been carried, in which an internal combustion engine was fitted for its propulsion. This boat has been used as a tender, carrying passengers to and from the shore, and has on occasion been impressed into service as a towboat. In this latter case the boat works at a very poor efficiency, but nevertheless, in general, it has been found to give a speed of three or four miles per hour, which has usually proved satisfactory. An example of this is illustrated this month on page 129.

In referring above to the *Northland,* we mentioned the two auxiliary engines generating electricity for various power and lighting purposes. This is a feature which is gaining more and more prominence, and which we may expect to see a very considerable item in vessels of the future, in which steam is not already provided by an equipment of boilers and steam machinery. The engine is particularly well adapted for this purpose, as it can be started almost at a moment's notice, and there is no fuel consumption whatever while the engine is not running. It differs markedly in this respect from the steam outfit, in which some time is required for getting up steam, and fuel is being burned, except in certain special cases, throughout a large portion of the time.

Progress of Naval Vessels.

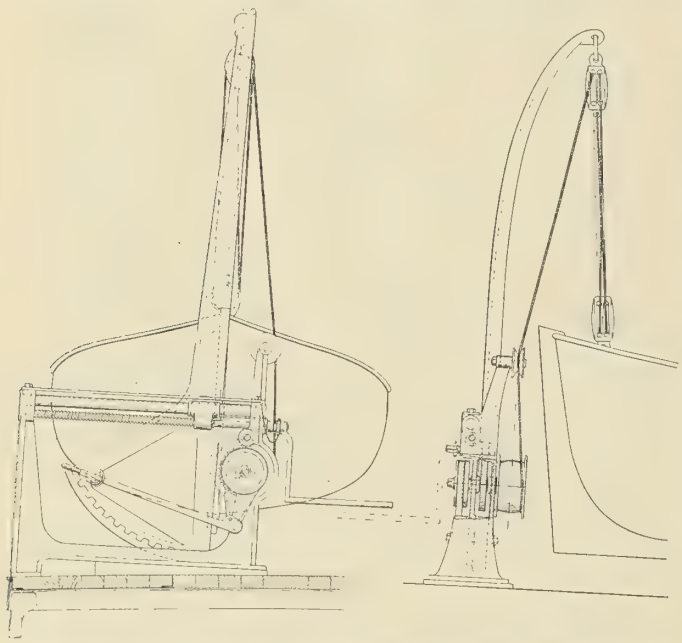
The Bureau of Construction and Repair, Navy Department, reports, Jan. 10, 1908, the following percentage of completion of vessels for the United States Navy:

	Tons.	Knots.		Dec. 1.	Jan. 1.
BATTLESHIPS.					
Mississippi	13,000	17	Wm. Cramp & Sons	98.01	98.65
Idaho	13,000	17	Wm.Cramp & Sons	91.24	94.12
New Hampshire	16,000	18	New York Shipbuilding Co	93.1	95.3
South Carolina	16,000	18½	Wm. Cramp & Sons	31.68	33.76
Michigan	16,000	18½	New York Shipbuilding Co	33.5	37.9
Delaware	20,000	21	Newport News S. B. & D. D. Co	5.08	7.05
North Dakota	20,000	21	Fore River Shipbuilding Co	7.84	12.7
ARMORED CRUISERS.					
North Carolina	14,500	22	Newport News Co	95.17	96.
Montana	14,500	22	Newport News Co	89.49	91.31
SCOUT CRUISERS.					
Chester	3,750	24	Bath Iron Works	94.	95.15
Birmingham	3,750	24	Fore River Shipbuilding Co	91.88	93.71
Salem	3,750	24	Fore River Shipbuilding Co	90.29	92.09
TORPEDO BOAT DESTROYERS.					
Number 17	700	28	Wm. Cramp & Sons	.....	0.0
Number 18	700	28	Wm. Cramp & Sons	.....	0.0
Number 19	700	28	New York Shipbuilding Co	.....	3.4
Number 20	700	28	Bath Iron Works	.....	0.0
Number 21	700	28	Bath Iron Works	.....	0.0
SUBMARINE TORPEDO BOATS.					
Cuttlefish	—	—	Fore River Shipbuilding Co	99.	99.

ENGINEERING SPECIALTIES.

Boat Lowering Gear.

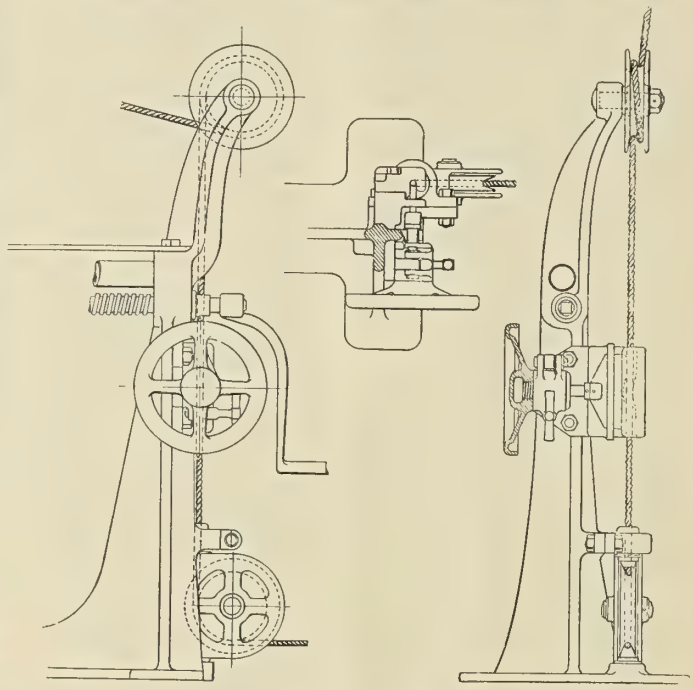
In combination with the Welin quadrant davit, it is desirable to have some means providing for the lowering and hoisting as well as the swinging out. Mr. Welin has already gotten out one or two designs for this purpose, and anyone insisting upon a winch arrangement attached to each davit or each pair of davits can have it. It should not be difficult to lower the boat



as long as the belaying pins are properly made; and the plan has been to keep the whole mechanism as simple as possible.

One of the illustrations shows a drum and brake attached to the Welin davit, and the other shows a simple clutch for lowering. With the former gear two men can swing out the boat, as with the ordinary quadrant davits, by turning the cranks, and after they have turned the boat out all they have to do is to take hold of the brake and lower away. This brake is so arranged that it gives the men, with very little effort, complete control of the lowering of the boat when it is fully loaded with passengers, as well as when empty. When it is desired to hoist the boat, this can be done by one man at each end, and by using the same cranks, only that they shift the cranks to the other pinions. This gear is very simple in its construction, and is made of the best material, so as not to suffer any corrosion whatever, and it works very well.

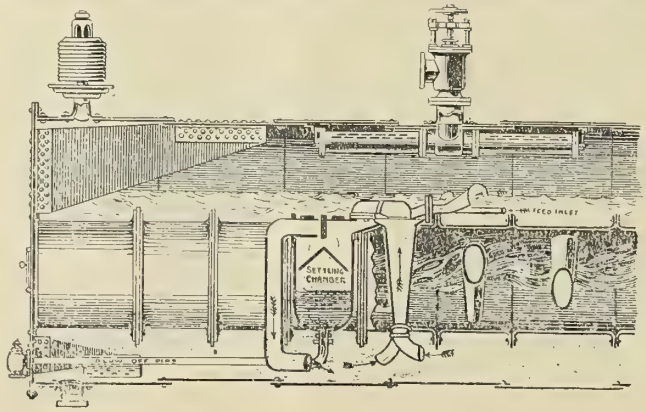
The other gear is still simpler, but is intended only for



lowering purposes, particularly on ships where wire falls are used. A great many ships nowadays carry several small winches upon the boat deck, to which the falls can readily be led when the crew wishes to hoist the boats. In such cases the simplest thing would be to apply this gear, which consists of a simple clutch brake, through which the wire is run and controlled when lowering the boat. (Welin Quadrant Davit Company, Hopetown House, London, E. C., and 17 Battery Place, New York.)

A Boiler-Water Circulator.

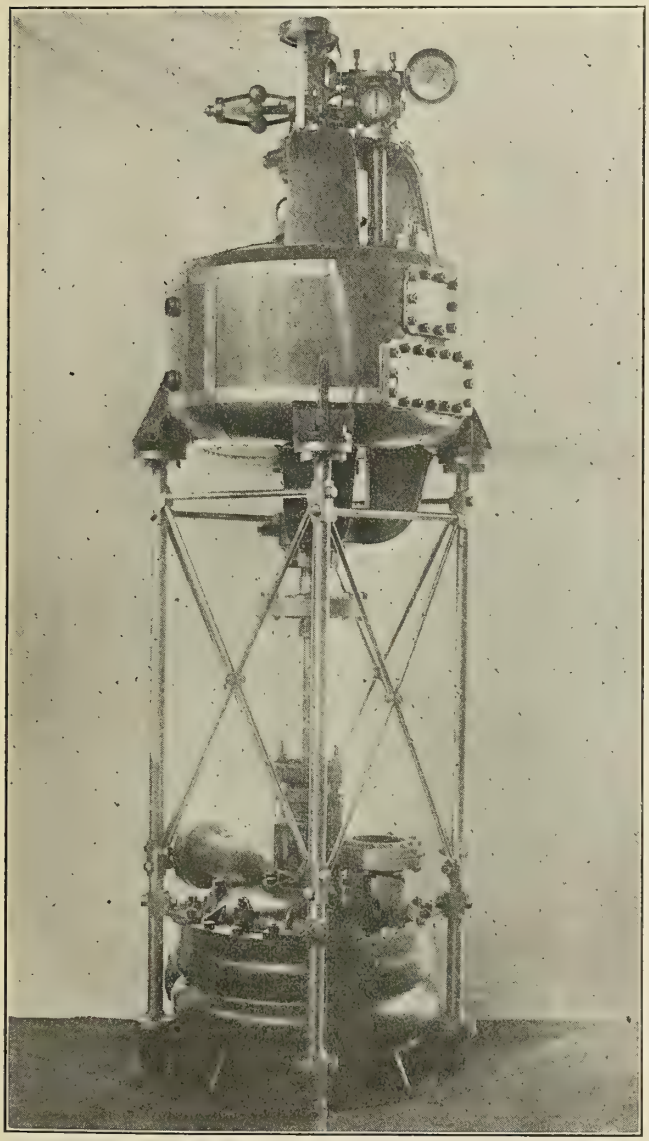
This device has been placed upon the market by the British Boiler Water Circulator Syndicate, of Nottingham. It is claimed not to require any structural alterations whatever to the boiler, and that it can be removed, inspected and replaced by an ordinary workman in about two hours. The object of the appliance is to increase the water circulation and facilitate steam generation by giving greater freedom to the gas-containing globules formed on the heating surfaces. It is entirely automatic in action. The feed water sent into the boiler must first pass through the apparatus illustrated, where it is not only heated, but is also cleansed and softened, while, further, the



grease is extracted. The feed inlet is indicated, and the settling chamber for impurities is also shown. The sediment, etc., can be ejected by means of a blow-off cock and pipe, and in fact the only attention necessary is that wanted for occasionally blowing out the impurities which are trapped. The construction is perfectly simple, and there are no delicate parts. The usefulness of moving water rapidly over the heated surfaces of boilers is now being recognized, and in increased steaming capacity and in the use of impure or dirty water this appliance should show advantages.

Turbine-Driven Centrifugal Hot Well Pump.

For the high vacuum required by steam turbines it has been found desirable, especially in large installations, to use separate pumps for drawing the condensed steam and the air from the condenser; forming what is known as the "dry vacuum system." The air is handled by an engine-driven reciprocating air pump, and as no water is handled the clearance can be made small, thus obtaining a high efficiency. The water is usually handled by a centrifugal hot-well pump, which is driven by an electric motor in the case of electric plants on shore, as it requires a high speed of rotation.

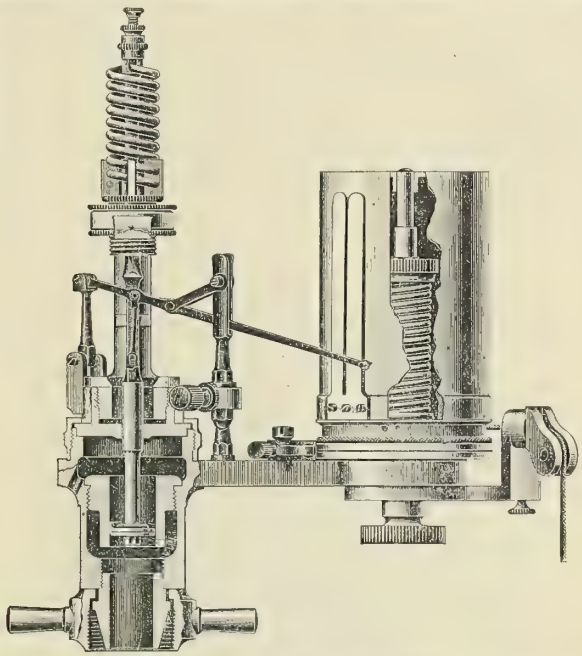


In using the dry vacuum system on turbine-driven vessels, it was considered objectionable to use a motor to drive the centrifugal hot-well pump, on account of the dampness and high temperature of the engine room; therefore direct drive by a steam turbine was used. The illustration shows the complete set as made by the Fore River Shipbuilding Company, Quincy, Mass., for the United States scout cruiser *Salem*, the main propelling machinery of which consists of Curtis marine turbines.

The pump end consists of a 4-inch two-stage volute centrifugal pump arranged to work with shaft vertical. The turbine is a two-stage Curtis turbine mounted above and directly connected to the pump. The entire set requires floor space of only 3 feet square, and is 9 feet 6 inches high over all. It is rated to deliver 300 gallons of water per minute from a 29-inch vacuum, and has a large overload capacity. The total weight is 5,850 pounds, and the speed is 1,200 revolutions per minute.

A New Indicator.

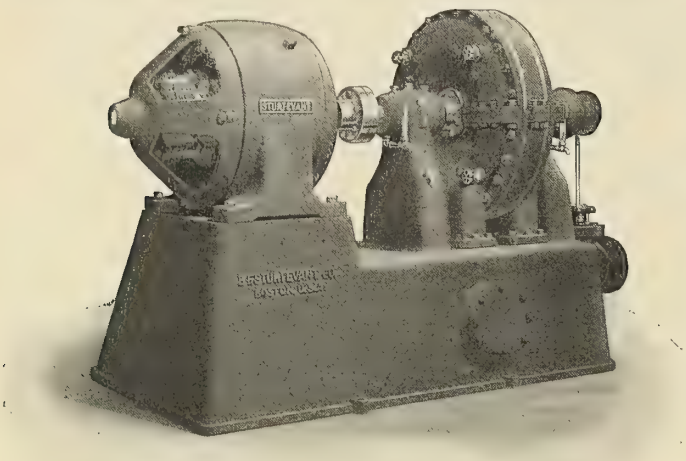
The Star Brass Manufacturing Company, Boston, Mass., has recently developed a new steam engine indicator of the outside spring type, which has been given severe tests, and is said to work extremely well. A number of the special features distinguishing this indicator from some of the others on the market include an elongation of the spring instead of compression; a comparative uniformity of temperature of the spring, due to its position outside the steam passages; lightness and accuracy of the spring; strength and rigidity of the pencil motion; a good diameter and length of piston; general solidity of the indicator frame; ease of change from right to left hand, also in changing tension of drum spring; accessibility of cylinder for removal or examination; the cylinder at all times surrounded by live steam, forming a steam jacket which is self-draining; and all chance of back pressure on top of the piston removed, owing to the provision of means for the passage of exhaust steam from the cylinder to the atmosphere.



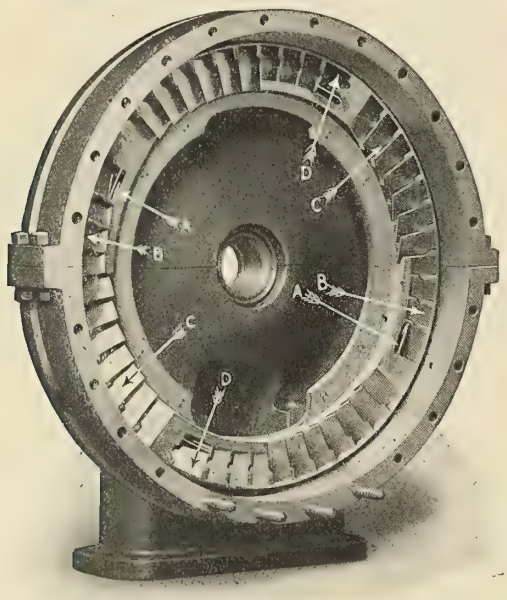
A bifurcated post is provided to guide the pencil arm, thus preventing any outward dislocation, with consequent cramping of the movement. The barrel is provided with stops engaging with lugs on the sleeve. This prevents any cramping in right and left motion. The adjustment of the atmospheric line is accomplished by means of washers on top of the barrel. The device is really a lock nut, and the position of the line is not changed by a change of spring or adjustment in any part of the instrument. It is said that eleven of these indicators are in use on the battleship *Vermont* and thirty-six in the Brooklyn Navy Yard.

Steam Turbine Lighting Set.

There have recently been placed on the market by the B. F. Sturtevant Company, Hyde Park, Mass., electric generating sets for ship lighting and kindred purposes, in which the prime mover is a steam turbine with one or more disks of vanes, all sizes below 200 horsepower being single stage, and those above, two, three and four-stage. The bucket wheel is



a single forging of open-hearth steel, with the buckets worked out of the solid metal on an automatic cutting machine. A shroud is left on the outside of the blades to insure against fouling. On either side of the bucket wheel is a stationary reverse guide ring of forged steel, as shown in one illustration. Steam nozzles of tobin bronze are inserted at *A*, and the steam, entering at these two points at the extremities of a diameter, acts upon buckets in the wheel, reacts in the reversing buckets, and returns again and again to the wheel, thus



taking a spiral path in the closed chambers or cylinders formed by the two sets of buckets. These guide buckets are shown at *B*, and the steam is exhausted at *C*. Midway between the two nozzles are small starting buckets *D*, increasing the starting torque. At full speed these are shut off.

To take a typical case, that of a unit of 50 horsepower, we find that the speed range under different conditions is from 1,600 to 3,000 revolutions per minute. The net weight of the turbine and its base, exclusive of the generator, is 2,400 pounds. The length of the turbine shaft is 44 inches, the extreme height is 50 inches, the exterior diameter of the turbine casing is 30 inches, and the base measures 35 by 32 inches over all.

TECHNICAL PUBLICATIONS.

Steam Turbines. By Carl C. Thomas, professor of marine engineering, Sibley College, Cornell University. Size, 5¾ by 9 inches. Pages, 334 + XXXII. Figures, 145. Plates, 20. New York, 1907: John Wiley & Sons. Price, $4.00. London: Chapman & Hall, Ltd. Price, 17s.

This is the third edition of the work, and includes new material on the design of the Curtis and Parsons types of turbine, as well as suggestions regarding turbine analyses and a diagram of the heat contents of steam, the superheated region of which is plotted from the results of the author's recent investigation of the specific heat of superheated steam, as presented before the American Society of Mechanical Engineers in December, 1907. The present edition contains also new material relating to the application of steam turbines to marine propulsion, including illustrations of some of the most recent turbine steamers. Only such details relating to present practice in turbine construction have been given as would suffice to illustrate the application of the principles.

Five of the ten chapters are devoted to theoretical considerations covering the subject of steam and its operation as an agent for the generation of power. This part of the subject covers nearly one-third of the text. The subject of the flow of steam through orifices, nozzles and turbine buckets is taken up as an intermediate stage between the theoretical part of the work and the practical discussion of turbines and their design. The last four chapters are devoted to descriptions of various types of turbines and their operation, including discussions of the broad classes into which turbines may be divided; while the tenth chapter is devoted to the marine steam turbine. In this chapter is a considerable amount of information regarding vessels which have been equipped with steam turbines, nearly all of them, of course, being of the Parsons type. Charts are given showing the relative economy as between turbines and reciprocating engines, and there are diagrams of engine rooms, photographs of various prominent turbine-propelled vessels, such as the *Lusitania* and the *Creole*, and many other illustrations covering the construction of the turbine and methods for measuring its action.

Introduction to the Study of Electrical Engineering. By Henry H. Norris, M. E., professor of electrical engineering, Sibley College, Cornell University. Size, 6 by 9 inches. Pages, 404 + XXIV. Figures, 179. New York, 1907: John Wiley & Sons. Price, $2.50 net. London: Chapman & Hall, Ltd. Price, 10/6 net.

The work is intended as a text-book for the use of students in electrical engineering at the higher technical colleges, and is intended to lay a foundation for more advanced analytical work by those pursuing such courses. It is designed to be used in combination with practical experience in either the construction or operation of electrical machinery, or with laboratory exercises, and as such should be sufficient to enable a student to intelligently select, install and operate machinery of this type.

The work is divided into thirteen chapters and an appendix. The chapters include, respectively: Historical Development of Electrical Engineering; Fundamental Electrical and Magnetic Quantities; Materials of Electrical Engineering; Electric Circuits; Magnetic Circuits; Construction of Electric Circuits; Operation of Electric Generators; Transformers and their Applications; Construction and Operation of Power

Stations; Electric Motors and their Applications; Electric Lighting and Heating; Electrical Measurements; the Transmission of Intelligence. The numerous illustrations are all of the line type, and nearly all of them have been made by the wax process, thus insuring splendid definition of lines and clearness in appearance.

Particularly interesting are the chapters devoted to electric generators and motors, these giving details regarding the proper operation and application of these units, and describing in some detail different types of motors and their construction. The last chapter deals with telegraphy in its various departments, including wireless telegraphy; the telautograph, designed for transmitting handwriting over a long distance; telephones, exchanges and central offices, and a short note on wireless telephony. A splendid index, covering about twenty-five pages, adds much to the value of the work.

Hints to Engineers for the Board of Trade Examinations. By W. D. Martin, M. I. E. S. Size, 4¾ by 7¼ inches. Pages, 105 + II. Figures, 35. Glasgow, 1908: James Munro & Company. Price, 2/6 net.

This little work is a collection of questions and answers on practical features connected with the operation of marine engines, boilers, pumps and auxiliaries, including a considerable amount of material upon such items as metals, gages, electricity, refrigeration, etc. The illustrations are all from line drawings, and cover, in general, indicator cards, gage glasses, various types of valves, pumps and boilers, as well as riveting. The work appears to be thoroughly practical and well adapted to its purpose. It covers simple computations and sketches as well as direct answers to questions.

Simple Problems in Marine Engineering Design (Including Turbines). By J. W. & R. M. Sothern. Size, 4¾ by 7¼ inches. Pages, 199 + XI. Glasgow, 1908: James Munro & Company. Price, 2/6 net.

This is the second edition of the work, which is divided into six sections: Simple Engineering Mathematics; General Problems; Engine Design; Boiler Design; Marine Turbine Design; Speed, Consumption and Horsepower Problems. The work is replete with rules and examples, and is intended to be used in connection with a theoretical work covering much the same subjects. With a good knowledge of the general features of the problems, however, the work is entire in itself, and would serve simply as a guide in the working out of the various features of marine engines, turbines and boilers. In each case the answer to every problem is given as a check to the work, and the total number of problems is sufficiently great to give a considerable scope in character. In many cases the problems are made more than usually specific by reference to the name of the ship under consideration.

Steam and Entropy Tables. By Cecil H. Peabody, professor of naval architecture and marine engineering, Massachusetts Institute of Technology. Size, 5¾ by 9 inches. Pages, 131 + XXIV. New York, 1907: John Wiley & Sons. Price, $1.00. London: Chapman & Hall, Ltd. Price 4/6 net.

This is the seventh edition of tables calculated twenty years ago to accompany the author's "Thermodynamics of the Steam Engine." Since that date important experimental investigations have been made, and this information has been used in recomputing the tables and in making certain changes facilitating their use. All the tables for saturated steam have columns of entropy, due to vaporization, and the table in metric units has been made into a conversion table, by aid of which properties can be found in either metric or English units, or a combination of the two may be used.

The introduction deals at some length with the properties of steam and other vapors, going into the subject from the theoretical standpoint and making use of the calculus. The first table covers saturated steam on the basis of temperature in degrees Fahrenheit. The second table covers saturated steam on the basis of pressure absolute in pounds per square inch. The third table covers saturated steam in metric and English units, based on temperatures. The next eight tables cover properties of saturated vapor of ether, alcohol, chloroform, carbon-disulphide, carbon-tetrachloride and aceton in metric units, and of ammonia and sulphur-dioxide in English units. The remaining tables include one showing the specific gravity and specific volume of liquids, one showing the volume of water at different temperatures based on its volume at 4 degrees C., conversion tables between inches of mercury and pounds per square inch, and a table of corrective factors for superheated steam.

The Temperature-Entropy table occupies fifty-two pages of the book, and is followed by tables of Naperian and common logarithms.

Les Flottes de Combat en 1908. By Commandant de Balincourt. Size, 6 by 4¾ inches. Pages, 787 + LVI. Figures, 386. Paris and Nancy, 1908: Berger-Levrault & Company. Price, 5 francs.

This is the seventh edition of a work devoted to the dissemination of information about the navies of the world. The general scheme is a left-hand page occupied by a line cut, showing an outboard profile and a battery plan of a vessel, while on the right-hand page is a description of that vessel, and, of course, at the same time, of its sister ships. The drawings show the general appearance of the ships, and the location and approximate thickness of the armor for the hull and battery. They show also the distribution of the various guns, and give a general idea as to the character of the designs from the point of view of the main elements of attack and defense. All the important ships of all the navies of the world are included, which makes the work a valuable one for reference. There is an alphabetical index at the rear.

Particularly interesting in the present number are figures of some of the latest vessels under construction. In many cases the details of these vessels are not well known, and it is possible that the real ships will show considerable changes from the drawings and descriptions here given. As indicating, however, such knowledge as is at present available on the subject, these are more than usually interesting. Among these vessels might be mentioned the four new German battleships, which carry sixteen 11-inch guns in six turrets, four of which turrets carry three guns each. These are arranged so that all may be fired on one broadside, the turrets at the ends being located as in the American battleship *Michigan,* while those amidships are placed *en echelon.* The ship is shown with two funnels. The German cruisers *"E"* and *"F"* are also illustrated, the former having ten 11-inch guns in six turrets, located like the six turrets on the American battleship *Connecticut.* There are four funnels. The armored cruiser *"F"* is shown with twelve 11-inch guns in pairs in six turrets, the arrangement of turrets being the same as in the German battleship, and allowing all of the guns to fire on one broadside. Six funnels are here shown, three forward and three aft.

Other ships, about which a certain amount of mystery has been maintained, include the new Italian battleship of 16,000 tons, which has eight 12-inch guns in pairs in four turrets, mounted one at either end of the ship, and two amidships *en echelon.* These may all be brought to bear on one broadside. Four funnels are shown, two forward and two aft. The Japanese battleship *Satsuma* is illustrated, showing a main battery of four 12-inch and twelve 10-inch guns, all mounted in pairs in turrets in the conventional manner. The new Japanese battleship *Huki* is also shown, with twelve 12-inch guns in pairs in six turrets. Four of these turrets are arranged in the same manner as in the battleship *Michigan;* the other two are located, one on either broadside, and the broadside fire is thus from ten of these guns; there are two funnels. The battleship-cruiser *Kurama* is shown, with three funnels, with a main battery of four 12-inch and eight 8-inch guns. The

former are mounted in the usual manner, while the 8-inch guns are located singly in eight turrets, four on either broadside.

QUERIES AND ANSWERS.

Questions concerning marine engineering will be answered by the Editor in this column. Each communication must bear the name and address of the writer.

Q. 392.—How much coal is used in a year by the merchant ships of the world? W. S. R.

A.—This is a subject which is exceedingly difficult of even approximate determination. Any estimate made would be subject to extreme guess work, because of the fact that marine engines differ so very markedly in general economy, particularly when viewed in respect to their widely varying sizes, designs and dates of construction. Without going pretty deeply into the matter, it would be totally impossible to arrive at any figures of even approximate exactness. Merchant ships, as a rule, operate at nearly full power, and hence are not subject to the comparatively heavy consumption of coal based upon the operation of large engines at a small fraction of their power, as in warships.

The merchant steam tonnage of the world at the present time is estimated at nearly 33,000,000 gross tons. Most of these ships are freighters with average speeds not exceeding 10 or 11 knots, which means a low proportion of horsepower. An offhand estimate of the latter might be put at 15,000,000 horsepower. This figure cannot be considered as accurate within 25 or 30 percent, but it serves at least as a basis for estimate.

Assuming that the average vessel is in service for one-half of the time, and that the coal consumption averages 2½ pounds per horsepower per hour, we have for each horsepower a total of 60 pounds of coal per day, and 183 days' steaming in the year. This makes each horsepower call for 11,000 pounds (about 5 tons) of coal per year. On this basis the total annual consumption would figure out at about 75,000,000 tons, which, we believe, is about 8 percent of the total annual coal production of the world.

Q. 393.—What is "cavitation" in a propeller? F. A. W.

A.—Cavitation is a phenomenon in water or other fluid, existent in connection with the propulsion of fast ships by screw propellers, in which the space immediately in the rear of the propeller blade is rendered more or less empty on account of the blade's rapid cleavage of the water, and the relatively slow action of the water in closing in behind the moving blade. This action breaks the continuity of the stream of water in which the propeller is acting, and renders it impossible for the propeller to develop upon the water the full effective thrust of which it would otherwise be capable. It is an unstable condition, and one which has caused much concern to designers of fast vessels.

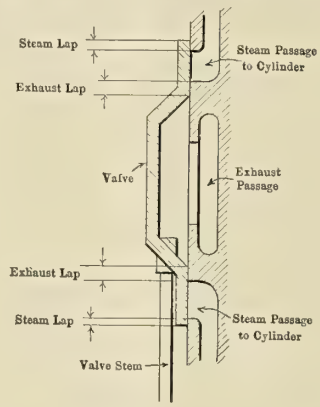
Q. 394.—How do you find the working pressure of a boiler? (2)—What is lap? What is lead? J. L. A.

A.—If the diameter of the shell, the thickness of the shell, and the character of riveting are known, we can figure the working pressure according to the formula:

$$P = \frac{T \times t}{\frac{1}{2} D \times f},$$

where T is the tensile strength of the steel of which the shell is made; t is the thickness of the boiler shell in inches; D is the diameter of the boiler in inches; and f is the factor of safety. Suppose we assume that we have material with a tensile strength of 60,000 pounds per square inch, and that the shell has a thickness of ¾ inch and a diameter of 150 inches. If we take a factor of safety of 6, we find that the allowable boiler pressure would be: $P = \frac{60{,}000 \times \frac{3}{4}}{75 \times 6} = 100$ pounds per square inch. This assumes that the longitudinal seam is single riveted. If it is double riveted, we can add 20 percent to the above figure, thus giving a boiler pressure of 120 pounds per square inch.

(2).—Lap and lead both refer to the position of a valve with regard to the steam passages of an engine in which the valve is working. These are best explained by a sketch. When the



valve surface overlaps the steam ports, the amount of this overlap is known as the "lap" of the valve. It is evident that in this case the valve must be moved through this distance before steam can be admitted to the cylinder. The lap of a valve is always measured in the middle of the stroke. On the steam edge of the valve this is called the "steam lap," and on the exhaust edge the "exhaust lap."

The amount of opening of the steam port at the moment when the piston begins its stroke is called the "lead" of the valve. This is brought about by regulating the angle between the position of the eccentric and the position of the crank. One object of this is to admit a slight amount of steam before the piston finishes its stroke, thus forming an elastic cushion against which the piston is brought gently to rest, and which then assists in reversing its motion.

Q. 395.—At about what speed should a four-cycle marine motor be run? I have been told that a propeller may be designed to fit any speed of revolution, while, on the other hand, I understand that a marine motor works best at about 600 revolutions. Does this vary with the model of the boat? Supposing that the wheel should turn about 600 revolutions, and that I have a motor which would run 1,200 revolutions, and I reduce the speed of the propeller shaft by a two-to-one gear, so that the required 600 revolutions were obtained. Am I wrong in assuming that a 10-horsepower motor, running at 1,200 revolutions, geared two to one, causing the wheel to run at 600 revolutions, would be equal to 20 horsepower, minus friction, by virtue of the two-to-one gears? Is this practical? If it is, it would certainly include a benefit in having the shaft parallel to the water line. B. B. S.

A.—The number of revolutions at which a marine engine should be run depends upon the power of the motor, and the model and speed of the boat. They may be successfully run anywhere between 200 and 1,100 revolutions, if they are well adapted to the particular circumstances of the case. It is practically impossible to design an efficient wheel for a low-speed cruising boat when the revolutions are over 500 or 600. In the high-powered, high-speed type of boat, revolutions may run as high as 1,000, but 600 revolutions is a very fair average for ordinary work.

Your scheme to obtain 20 horsepower with a 10-horsepower motor is, of course, absolutely impossible. It certainly would not have been neglected all these years if it could have been done. But you are not doubling the horsepower when you reduce the speed; you are simply doubling the acting force, but moving this force only half as fast. The horsepower, which is a product of force and speed, ought to be the same in either case, neglecting friction. Taking friction into account, you

will have less horsepower on the propeller shaft with your scheme than you will have on the crankshaft. The efficiency of gears, when well designed, ranges between 85 and 95 percent; that is, 10 horsepower at the crankshaft of your motor would give you perhaps 9 horsepower at the propeller shaft.

T. M. B.

Q. 396.—Kindly inform me how I may remedy the "grunting" in the intermediate pressure cylinder of a triple-expansion, four-cylinder marine engine, every time we get under way. The diameters of the cylinders are: H. P., 38.5; I. P., 63.5; two L. P., 74 inches each; boiler pressure is usually kept at 250 pounds. All cylinders are steam-jacketed, and we allow from 2 to 3 hours in heating up the main engines. As the revolutions are increased, this noise will decrease, until a speed of 60 R. P. M. is obtained, when it will stop altogether. Shutting the steam off of the jackets also proved to decrease this noise.

A. N. M.

A.—The "grunting" of the cylinder in getting under way is not at all unusual; for most engines grunt for 10 or 15 minutes after steam is admitted, no matter how thoroughly they may be warmed up. This is said to be due to the dryness of the cylinder walls, and a remedy is to inject a pint of water into the cylinder when it begins to grunt. This would probably stop the noise. Shutting the steam off the jackets, as mentioned, would also operate to decrease the noise, because of the fact that this permits greater cylinder condensation, the water from which tends to lubricate the cylinder walls.

C. A. M.

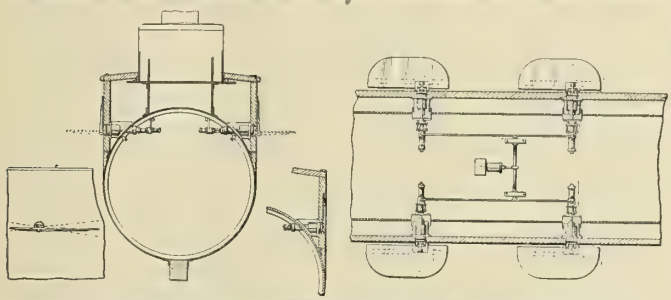
SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

872,842. SUBMERGIBLE VESSEL. EDWARD L. PEACOCK, MONTREAL, CANADA, ASSIGNOR TO THE LAKE TORPEDO BOAT COMPANY, BRIDGEPORT, CONN., A CORPORTION OF NEW JERSEY.

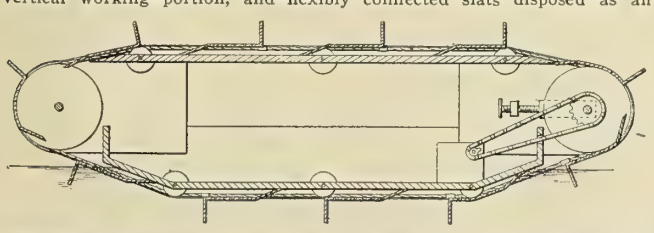
Abstract.—The object of the invention is to adapt the hydroplanes to lie flat against or flush with the side of the vessel when the latter is running on the surface, and to render them capable of being quickly



opened or adjusted to a horizontal position, from which they may be turned axially so as to present either their upper or lower surface to the water at any angle, to cause the vessel to rise or sink as the occasion requires, means being employed and operable from within the vessel for operating the hydroplanes and holding them in either position, and for adjusting them axially and holding them in their adjusted position. Sixteen claims.

872,870. BOAT. BENJAMIN F. WATERS, DOVER, N. C.

Claim.—A boat comprising a body, pulleys mounted in pairs at the ends thereof, parallel cables trained over said pulleys and transverse paddles connecting said cables, each of said paddles comprising a vertical working portion, and flexibly connected slats disposed as an



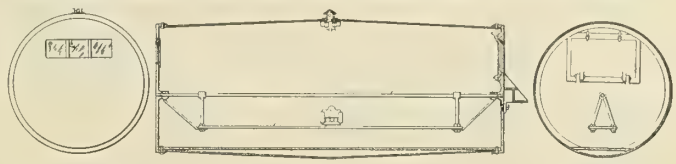
entirety in a horizontal plane, the end ones of said slats being provided with an inwardly extending inclined deflecting blade. One claim.

872,759. ELECTROLYTIC SHIP-BOTTOM PROTECTOR. JOHN H. SCHONEBERGER AND GEORGE W. FRAZIER, ALLEGHENY, PA., ASSIGNORS TO PITTSBURG ELECTROLYTIC MANUFACTURING COMPANY, A CORPORATION.

Abstract.—The invention has for its object the production and arrangement of certain electrochemically related elements whereby the electrolysis of sea water is effected continuously, and the submerged, unpainted metal of a vessel is gradually coated with a more or less adherent layer of hydrogen and sodium hydrate, and thereby protected from the ordinary attacks of vegetable, barnacle, molluscous or insect parasites. Ten claims.

873,557. LIFEBOAT. THOMAS B. KING, EPHRATA, WASH.

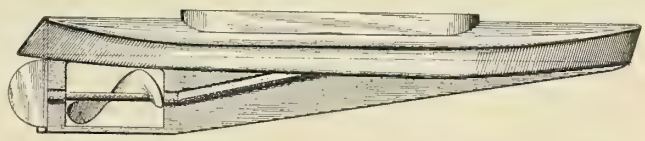
Claim.—2. A boat comprising circular heads, a substantially cylindrical body secured at its ends to the heads, a shaft secured at its ends



to the heads at points below the centers thereof, and a seat suspended from and pivotally connected to the shaft, and constituting a weight to hold the boat normally upright. Three claims.

873,614. MOTOR BOAT. VICTOR M. SALO AND JOHN RUKONEN, CHICAGO.

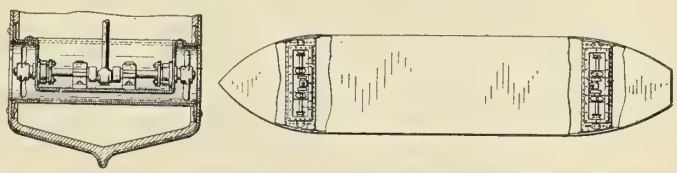
Claim.—In a motor boat, the combination consisting of a metallic fin keel tapering from the bow to a point below the propeller, and from thence parallel with the waterline to the stern, said keel having



a step to support the end of a rudder post, and opening to permit the rotation of the propeller therein, bearings to support the propeller shaft and a connecting shaft tube extending from one of said bearings diagonally upwards into the hull; a propeller shaft supported in said bearings parallel with the waterline; a propeller affixed on said shaft within the opening in said keel; and a connecting shaft in said tube connected with the propeller shaft and a motor in the boat. One claim.

873,818. STEERING VESSELS. HERMANN W. WILKE, LONG ISLAND CITY.

Claim 1.—The combination with a vessel, of transversely extending pipes at the fore and aft ends and secured to the side walls of the vessel and terminating in openings therein, the pipes being cut out at the upper surface, cylindrical casings secured to said pipes and projecting downward through the cut-out portion of the latter, crank shafts extending longitudinally through and supported in said casings, propel-



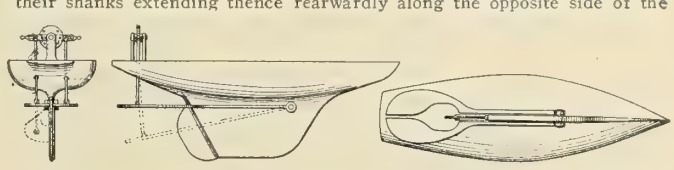
lers arranged at each end of said shafts, the propellers being adapted to draw in water at one side of the vessel and to throw it out in a jet on the other side, to steer the vessel, and means for operating said propeller shafts. Two claims.

873,899. CURRENT-SUPPLYING ARRANGEMENT. BERNHARD SALOMON, FRANKFORT-ON-THE-MAIN, GERMANY, ASSIGNOR TO FELTEN UND GUILLEAUME-LAHMEYERWERKE AKTIEN-GESELLSCHAFT, FRANKFORT-ON-THE-MAIN.

Abstract.—The invention relates to a new system of supplying electric current from a stationary conductor to ships, vehicles and the like. This system comprises a subsidiary motor-vehicle, motor-ship and the like, which is arranged to follow the conductor and to take up the current from the same by means of a slide bow or trolley, and is in turn connected with the ship, vehicle and the like to be propelled or driven by means of a conductor. Eight claims.

874,031. HULL OF VESSELS. ISAAC E. PALMER, MIDDLETOWN, CONN.

Claim.—The combination with the hull of a vessel, of wings independently movable in a vertical direction, and means for raising and lowering the said wings and for locking them in the desired adjustment, the wings being hinged one on each of the opposite sides of the keel, their shanks extending thence rearwardly along the opposite side of the



keel, and the blades of the wings gradually extending laterally as they pass under the overhanging stern of the vessel on opposite sides of the central vertical longitudinal plane thereof. One claim.

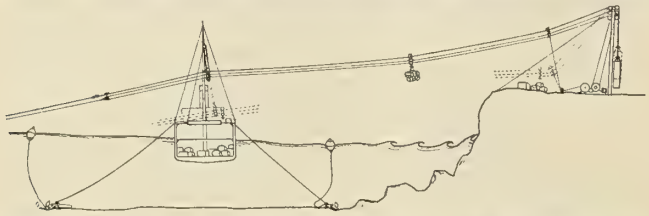
873,917. SIGNAL-BUOY. THOMAS L. WILLSON, OTTAWA, CANADA, ASSIGNOR TO UNITED STATES MARINE SIGNAL COMPANY, JERSEY CITY, A CORPORATION OF NEW JERSEY.

Claim 1.—A bellbuoy including in combination a bell, a striker, a

spring for forcing said striker toward the bell, and a cam for retracting and suddenly releasing said spring, whereby the striker is forced toward the bell, a fixed stop to limit the forward movement of said spring before the striking movement is completed and a stop carried by the striker and adapted to compress the spring against said fixed stop by the momentum of the striker, to permit the completion of the stroke and then retract the striker. Two claims.

874,223. CONVEYING APPARATUS. THOMAS S. MILLER, SOUTH ORANGE, N. J.

Claim 1.—In combination, a traction rope extending from the shore over and beyond a vessel, an anchorage seaward of the vessel whereby



said traction rope is held distended, a load carriage operated by said traction rope and a support for said traction rope on the vessel between the load carriage and the seaward end of said traction rope. Twenty-two claims.

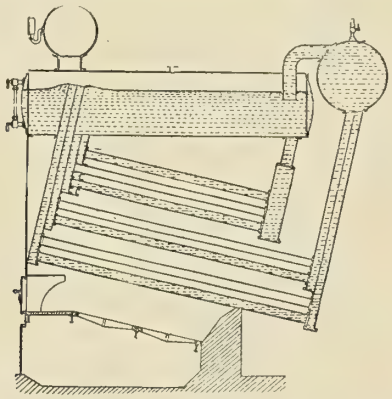
874,255. DEVICE FOR DIMINISHING THE ROLLING MOTION OF SHIPS. RUDOLF SKUTSCH, BRUNSWICK, GERMANY.

Claim 1.—A device for diminishing rolling movements of a vessel without simultaneously producing pitching movement, comprising a pair of oppositely rotatable elements mounted in swinging supports adapted to be braked, means for braking said supports whereby couples of force acting upon the vessel are provided, those of the couples which attempt to produce a pitching movement counteracting each other, thereby preventing pitching movement of the vessel. Two claims.

British patents compiled by Edwards & Co., chartered patent agents and engineers, Chancery Lane Station Chambers, London, W. C.

16,816. WATERTUBE STEAM GENERATORS. H. VAN BERESTEYN, BRUSSELS, BELGIUM.

In boilers of the large tube type, arrangements are provided whereby the circulation in any one of the generating tubes is independent of that in the other tubes. The headers of the lower nest of tubes are divided into as many compartments as there are tubes. The compartments in the front header extend into the drum and terminate at the



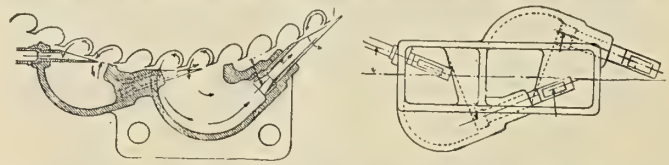
normal level. The rear header communicates above with a water drum, which is connected with the drum by a pipe. The upper nest of tubes is connected at the rear and at the front to divided headers. In a modification, a single rear header is employed for both nests of tubes. This header may be divided with a chamber at the top, common to all the compartments; or, with each compartment connected by a separate pipe with a divided chamber. In some cases, the tubes are connected directly with the drum at one or both ends.

17,191. FILTERS. H. B. WATSON AND T. C. BILLETOP, HIGH BRIDGE WORKS, NEWCASTLE-ON-TYNE.

Filtering units are formed by inclosing sponges, shavings, cocoanut fiber, etc., between flat perforated plates connected together in pairs. In one form of apparatus, the units are held in grooves formed in the side of the casing and in a partition. The liquid entering from the branch passes through one or other of the units to the compartments, and leaves through the valve. The inlet valve also controls the by-pass passage. A thin lid transmits the pressure of the cover to hold the units down in position. In modifications, only two units are used, the units in one case being curved around a central discharge compartment. In a further modification, the grids are arranged in inner and outer sets, with the filtering material between them. The upper portions of the grids are not perforated, but are left plain to prevent the passage of unfiltered water, due to settling of the filtering material.

16,874. IMPACT WHEEL TURBINES. N. BECKER, FRANKFURT-AM-MAIN, GERMANY.

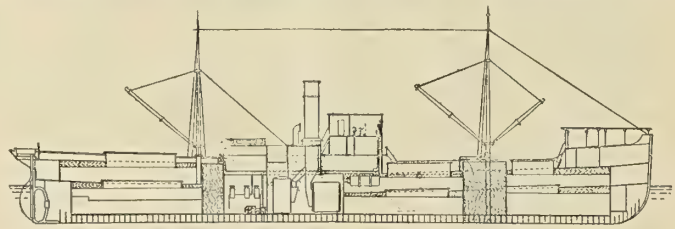
Steam is emitted from the nozzle, rebounds from the buckets into a bowl-shaped cell, from whence it is again directed to the buckets by another nozzle, and so on. The nozzles are inclined both to the tangent to



the periphery of the wheel, and to the plane of revolution of the wheel. The former inclinations are equal. The latter inclinations increase as the expansion progresses.

17,279. SHIPS' TANKS. L. A. LAMMERTS AND A. D. F. W. LICHTENBELT, ROTTERDAM, HOLLAND.

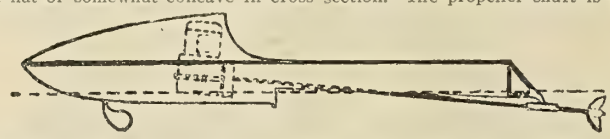
In the event of a collision, stranding, or other accident, water is discharged from closed waterballast tanks by means of compressed air, in order to increase the buoyancy of the ship, or of one end of it, as



required. On operating a three-way cock on the bridge, one tank is placed in communication with the atmosphere, and water flows out through pipes until the level in the tank is the same as that of the water outside the ship, a whistle being sounded by the air drawn through. When the whistle ceases to sound, the cock is moved to the second position, and compressed air from two of three reservoir tanks forces the remaining water from the first tank. The reservoirs are supplied with air by means of an airpump, and the air pressure is indicated by a gage on bridge. Airtight compartments under each deck are formed by horizontal and vertical plates, and are filled with displaceable water or supplied continuously with compressed air.

17,360. BOATS' HULLS. A. E. KNIGHT, LONDON, S. W.

The lower surface of the afterbody of a navigable vessel is in a distinctly different plane from that of the forebody. The surface may be flat or somewhat concave in cross section. The propeller shaft is in-



clined and the propeller arranged some distance beyond the stern. The forebody is of ordinary construction. When the vessel is traveling, the afterbody is lifted more or less out of the water, and a film of air is contained between the surface of the vessel and the water surface.

18,095. WATERTUBE STEAM GENERATORS. W. J. PARKYN, T. BRADLEY AND J. GRESTY, Engineering Works, Dukinfield.

According to the present invention, the various pipe connections are made with detachable joints. Flanged joints are shown, but screwed nipples or the like may be employed. Hot water, taken either from the outlet end of the feedheater or the drum, is mixed with the cold feed before it enters the heater. The hot water may be supplied to the suction side of the feed pump by small pipes. The boiler casing is preferably lined with suitable material, such as fire-tiles, in which passages for heating the air supply to the ashpit and above the fire are formed.

17,590. ELASTIC FLUID TURBINES. R. W. PATTERSON, PARTICK, AND R. P. RAMSAY, SCOTSTOUN.

Relates to multi-stage steam turbines in which the two elements rotate in opposite directions. The inner element is supported by two perforated disks mounted on hollow shafts rotating in bearings. The outer element is supported by bearings, and is coupled to a gear wheel which gears with a wheel on the inner element through pinions. Steam is supplied to the annulus by pipes connected to a pipe passing through the hollow shaft, and is exhausted through the opposite trunnion by way of ports, part of the steam having passed through the interior of the inner element.